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Lead-Cleaning Efficacy Follow-Up Study

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Technical Branch
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Office of Prevention, Pesticides, and Toxic Substances
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CONTRIBUTING ORGANIZATIONS

The study described in this report was funded by the United States Environmental Protection Agency (EPA). The study was managed by EPA and conducted by Midwest Research Institute (MRI) with the assistance of Westat, Inc., under contract to EPA. Each organization's responsibilities are listed below.

Midwest Research Institute (MRI)

MRI, assisted by Westat, Inc., worked with EPA to design this follow-up study to a previous EPA study performed jointly by Westat and MRI. MRI then conducted all laboratory sampling and chemical analyses. Upon completion of the laboratory activities, MRI performed the statistical analysis and prepared and edited the report.

Westat, Inc.

Westat, Inc., assisted MRI in the development of the experimental design based on the results from the previous study and EPA's requirements for this follow-up study.

United States Environmental Protection Agency

EPA was responsible for managing the study; providing technical oversight, guidance and direction; and overseeing the peer review and finalization of the report. Dr. Benjamin S. Lim was the Work Assignment Manager for this task, and the EPA Project Officer was Mr. Samuel F. Brown.

Executive Summary

In the past, the U.S. Environmental Protection Agency (EPA) recommended the use of trisodium phosphate (TSP) detergent to clean lead-contaminated dust from surfaces after residential lead hazard control work to achieve post-abatement clearance standards. This recommendation was often assumed to apply to the general cleaning of lead-contaminated dust during ongoing exposure reduction activities. Because of the negative impact of phosphate detergents on the ecology of aquatic ecosystems, questions arose as to the scientific basis for recommending TSP and about the effectiveness of other cleaners.

In 1996, an EPA study was conducted to determine the relative effectiveness of many commercially available cleaners for cleaning lead-contaminated soil from surfaces similar to floors and walls. The results of that study, to be used to support EPA's recommendations to the public on methods for removing lead-contaminated dust and soil from surfaces, are published in the EPA report entitled "Laboratory Study of Lead-Cleaning Efficacy," publication No. EPA-747-R-97-002, March 1997.[1] That study was designed to determine if and how cleaner characteristics such as pH, phosphate content, surfactant type, and surface tension affect the relative cleaning efficacy as measured by the quantity of lead picked up by a baby wipe after the test surfaces were cleaned. Based on the results reported in the study, it was shown that of the cleaner characteristics tested, only surface tension appeared to be related to how well the cleaners cleaned the lead-containing soil from the surfaces; cleaners with lower surface tensions appeared to clean the surfaces slightly better than cleaners with higher surface tension. However, surface tension was a measured cleaning agent property, not a controlled variable.

The results from this previous study provided only weak evidence for the selection of a cleaning detergent for the purpose of cleaning lead-contaminated dust from surfaces in homes. By design and availability, the commercially available cleaners used in the previous study covered only a narrow range of surface tension and phosphate content. The EPA thus sponsored a follow-up study to further investigate the effect of surface tension and phosphate content on lead-cleaning efficacy.

This follow-up study consisted of the selection of a commercially available hand dishwashing detergent to assess the effect of surface tension on lead-cleaning efficacy of a standard sponge-cleaning procedure. Four surface tensions, 30, 40, 60, and 70 dyne/cm, were approximated by mixing the four amounts of cleaning agent of 6.36, 0.050, 0.008, and 0 g, respectively, into 1 gallon of water. Additionally, the effect of phosphate content on lead-cleaning efficacy was investigated by adding known amounts of anhydrous trisodium phosphate to the cleaning solutions corresponding to concentrations of 0, 3, 11, and 14 grams of phosphorus per gallon (g P/gal). This design provided 16 cleaning solutions to be tested.

Tests were conducted using two types of surfaces—enamel-painted birch plywood and latex-painted birch plywood—each one foot square (called coupons). Two types of soil

were used: one contained some vegetable oil, the other, a dry soil, contained no added oil. A total of 128 coupons were soiled then cleaned with a sponge containing the cleaning solution. Half the coupons were then wiped with a commercially available, pre-wetted baby wipe, the other half were not. All coupons were then cored to obtain coupon samples. All sponges, wipes, and core samples were analyzed by ICP and GFAA, if necessary, for lead content. The percentage of lead removed by the sponge and the wipe and that remaining on the coupon was statistically analyzed to quantify the effect, if any, of surface tension and phosphate content, on the cleaning efficacy of the various cleaning solutions.

Based on the 128 sponge-cleaning tests, 64 wipe tests, 64 coupon tests from wiped surfaces, and 64 coupon tests from 64 non-wiped surfaces, the following conclusions were drawn.

- Approximately 72 to 74 percent of the lead applied was removed by the sponge.
- Approximately 1.3 to 1.6 percent of the lead applied was removed by the wipes after the surfaces were cleaned by the sponge.
- Approximately 20 to 23 percent of the lead applied remained on the coupons after sponge-cleaning and wiping.
- Approximately 22 to 26 percent of the lead applied remained on the coupons after sponge-cleaning only.
- The total percentage of lead accounted for in this study was estimated at approximately 95 to 99 percent, leaving approximately 0.9 to 5.3 percent unaccounted for.

The amount of lead picked up by the wipe from the sponge-cleaned surface was estimated at approximately 2 percent in the previous study. This estimate is comparable to the slightly lower estimate of 1.3 to 1.6 percent found in this study.

In contrast, the estimated amount of lead remaining on the cleaned surface, expressed in percentage of applied amount, is significantly higher in this study than in the previous study: 20 to 26 percent versus 7 percent. The estimate of 20 to 26 percent was directly estimated from cleaning tests in this study. Since neither sponges nor surface samples were analyzed in the previous study, the percentage of lead removed by a cleaner and sponge was based on a small set of wipe cleaning experiments. In that study, the assumption was made that two baby wipes would remove similar quantities of lead as would a cleaner and sponge. That estimate was found to be roughly 91 percent. By subtraction, the percentage of lead remaining on a cleaned and wiped surface was estimated at 100 percent – 91 percent – 2 percent = 7 percent.

The analysis of the effect of surface tension and phosphate content on cleaning efficacy provided the following results:

- Overall, surface tension and phosphate content had no statistically significant effect on the residual lead found on coupons. This is true whether the coupons were wiped or not after sponge cleaning.

- When sponge and wipe results were examined, both surface tension and phosphate content had an overall statistically significant effect on cleaning efficacy. However, no consistent pattern in the effect of these two factors on cleaning efficacy could be found. That is, no monotonic relationship could be found between the levels (values) of these factors and the resulting cleaning efficacy. This lack of consistent pattern was found in sponges and wipes. For example:

  - Across all coupon surface types, soil types, and phosphate content levels, it was found that lower surface tension cleaning solutions are associated with better sponge cleaning. However, this significant surface tension effect is masked by interactions with the type of coupon surface and soil type.

  - When looking individually at the four combinations of surface type and soil type, surface tension was no longer predicting cleaning efficacy when using a sponge.

  - Only when dry soil was applied to latex-painted surfaces did phosphate content affect cleaning efficacy when a sponge was used. However, no meaningful relationship between cleaning efficacy and phosphate content level could be found. In other words, cleaning efficacy did not increase or decrease consistently with phosphate content.

  - Surface tension had a small but significant effect on the ability of wipes to pick up lead from all surfaces. It was found that the percentage amount of lead picked up by the wipe increased with increasing surface tension of the cleaning solution.

The effect of surface type and soil type on cleaning efficacy was also investigated. The analysis provided the following results:

- Surface type (enamel- and latex-painted plywood surfaces), soil type (dry and oily), and their interaction had in most cases a significant effect on lead cleaning efficacy.

- Although latex-painted surfaces are rougher than enamel-painted surfaces, the percentage of lead found in the sponge did not reflect that fact. However, wipes picked up a higher percentage lead from latex-painted surfaces than from enamel-

painted surfaces after sponge-cleaning, possibly indicating that rougher surfaces are more difficult to clean.

- The above finding could not be confirmed when looking at the residual lead on the coupons. In those cases (wiped and non-wiped coupons), the trend was counter-intuitive in that a higher residual lead was found on enamel- (smooth) than latex- (rough) painted surface.

- Generally, an oily soil surface was more difficult to clean than a dry soil surface.

Based on this study, no conclusive evidence was found to recommend trisodium phosphate (TSP) or high phosphate detergent cleaners for lead removal inside homes. In addition, the weak evidence found in the previous study that cleaners with lower surface tension appear to clean soiled surfaces slightly better than cleaners with high surface tension could neither be refuted nor strengthened. However, EPA still recommends that either a general all-purpose cleaner or a cleaner made specifically for lead should be used for both general cleaning and for post-intervention cleaning. Household cleaning using one of these cleaning agents is likely to remove more leaded soil and dust than does water alone.

The extent to which these conclusions, based on laboratory investigation, apply to homes in real-life situations is a matter of judgment. Cleaning home interiors with a damp sponge or cloth will likely remove significant amounts of lead-containing soils. Water alone would do an adequate job, but considering that most cleaning is done by repeatedly wiping a soiled surface and rinsing the sponge or cloth into a bulk cleaning solution, a common household cleaner would probably help keep the soil in suspension, thus lessening the redeposition of the soil back onto the surface being cleaned. General home cleaning will thus further assist in the prevention of childhood lead poisoning.

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Section 1
Introduction

1.1 Background

In the past, the United States Environmental Protection Agency (EPA) recommended the use of trisodium phosphate (TSP), a high-phosphate detergent, to clean lead-contaminated dust from surfaces, both as a general practice and after remediation of lead-based paint. The recommendation to use TSP was often assumed to cover the general cleaning of lead-contaminated dust during exposure reduction activities. Lead-contaminated dust can result from deteriorated or disturbed lead-based paint, lead-contaminated soil and street dust, or other sources. Because of the negative impact of phosphate on the ecology of aquatic ecosystems, questions arose as to the scientific basis of its recommended use and about the effectiveness of other cleaners, in particular, low-phosphate cleaners.

1.2 Summary of Previous Lead-Cleaning Efficacy Study

In 1996, an EPA study was conducted to determine the relative effectiveness of different cleaning agents for cleaning lead-contaminated soil from surfaces similar to floors and walls. The results of that study, to be used to support EPA's recommendations to the public on methods for cleaning surfaces with lead-contaminated dust and soil, are published in the EPA report titled "Laboratory Study of Lead-Cleaning Efficacy," publication No. EPA-747-R-97-002, March 1997.[1]

The objectives of that study were to assess the relative cleaning efficacy of 32 cleaners (commercially available cleaning agents), tap water of average hardness, and TSP as a function of the physical and chemical characteristics of the cleaners. Cleaning efficacy was measured by the quantity of lead (referred to as wipe lead) picked up by a commercially available, pre-wetted baby wipe after the surface had been cleaned. This measure of cleaning effectiveness is used by abatement contractors to assess lead dust cleanup after remediation of lead-based paint. Risk assessors also do wipe sampling of dust to determine if lead hazards are present in a home.

The study was designed to determine if and how the following four cleaner characteristics affect the relative cleaning efficacy as measured by the wipe lead:

- pH—The measurement of acidity and alkalinity of a solution. Solutions with a pH greater than 7.0 are basic (alkaline); solutions with a pH less than 7.0 are acidic; pure water has a pH of 7.0.

- Phosphate content—The amount, in grams of phosphorus per gallon of cleaning solution. Various phosphate chemicals have traditionally been added to detergent cleaners to enhance their effectiveness.

- Surfactant type—The classification of the surfactant, or wetting agent, in the cleaner. There are four major classifications of surfactants, of which two were considered in this study: anionic and nonionic. Anionic surfactants are water soluble and have negative ions. Nonionic surfactants, a class of synthetic surfactants, are the most widely used for surface cleaning and have no charge. Cleaning solutions with a blend of anionic and non-ionic surfactants types were also included in the study.

- Surface tension (dyne/cm)—The force acting on a liquid's surface caused by intermolecular bonding interaction. Surface tension is a measure of how well the cleaning solution will wet the surface to be cleaned: the lower the surface tension of the cleaning solution, the more effectively the cleaning solution will wet the surface. Pure water (without a cleaner) has a high surface tension of 70 dyne/cm. Cleaners, by design, lower the surface tension of water to low values of around 30 dyne/cm.

The tests were conducted using five types of surfaces selected to represent those commonly found in residential settings: vinyl tile, latex paint on drywall, enamel paint on birch, lacquer (Fabulon) on oak, and latex paint on birch. In addition to varying the types of surfaces tested, two types of leaded soil were used. One soil type contained vegetable oil (oily soil); the other contained no vegetable oil (dry soil). Each lead-containing soil mixture was dispersed in a mineral spirits carrier, spread on a test surface in a standardized manner, and allowed to dry before the surfaces were cleaned.

Based on the results reported in the study, the following conclusions were drawn:

1. Roughly 91 percent of the applied lead is removed by cleaning the surface.

2. Roughly 2 percent of lead is recovered from the baby wipe after cleaning the surface.

3. Therefore, roughly 7 percent of the applied lead remains on the surface.

4. Of the cleaner characteristics tested, only surface tension appears to be related to how well the cleaners cleaned the lead-containing soil from the surfaces; cleaners with lower surface tension appear to clean the soiled surfaces slightly better than cleaners with higher surface tension. However, surface tension was a measured cleaning agent property, not a controlled variable.

The results obtained provided only weak evidence for the selection of a cleaning detergent for the purpose of cleaning lead-contaminated dust from surfaces in homes. The

commercially available cleaners used in the study were selected based on their pH, the type of surfactant, and their phosphate content. However, cleaning agents currently available to the consumer (1) are relatively high in pH for corrosion control of steel machine parts; (2) employ surfactant types, the use of which is based on the profit margin of the cleaning product; and (3) include a phosphate content that is minimized or eliminated due to regulatory and marketing constraints. As a result, there was little latitude to study statistically the effects and interactions of the selected parameters on lead-cleaning efficacy: most of the cleaning agents studied were high in pH, of the anionic and nonionic surfactant type, and low in phosphate content. Furthermore, due to the selection criteria, the cleaning agents tested covered the range of surface tensions from 25 to 50 dyne/cm, with most of the values being below 35 dyne/cm.

1.3 Objectives of Follow-Up Study

Based on the statistical results from the previous study and given its limitations, EPA proposed a follow-up study to further investigate the effect of surface tension and phosphate content on lead-cleaning efficacy. Using a single cleaning agent at various dilution levels, with the addition of known amounts of phosphate, a study was thus undertaken to accomplish the following:

1. Determine the lead-removal efficacy of a cleaning agent as a function of its surface tension, covering a range of surface tensions of approximately 30 to 70 dyne/cm.

2. Determine the lead-removal efficacy of a cleaning agent as a function of its phosphate content, covering a range corresponding to approximately 0 to 14 grams of phosphorus per gallon of cleaning agent.

3. Quantify the amount of lead actually removed from the test coupon surface by the sponge-cleaning procedure. This would be accomplished by measuring the lead content of the sponge, cleaning agent, and rinse water from the sponge-cleaning process for individual test coupons.

4. Quantify the amount of lead remaining on the surface of the test coupon. This would be accomplished by measuring the lead content of core samples taken from the substrates.

Of the five previously tested substrates, only two, enamel-painted birch plywood and latex-painted birch plywood, were selected. As in the previous study, two types of leaded soil, dry and oily, were used to soil the test coupons.

1.4 Overview of the Report

The study results as they apply directly to the objectives are presented in Section 2. A synopsis of the previous lead-cleaning efficacy study[1] is provided in that section also. The study design is described in Section 3. Section 4 describes laboratory data collection procedures for the preparation, soiling, and cleaning of the coupons, and the analytical quantification of lead. Section 5 summarizes the QA/QC results of the study. The characterization of the cleaning solutions and the soil is described in Section 6. Finally, the statistical results are presented in Section 7. Appendices A and B provide supporting analytical data.

Section 2
Study Summary

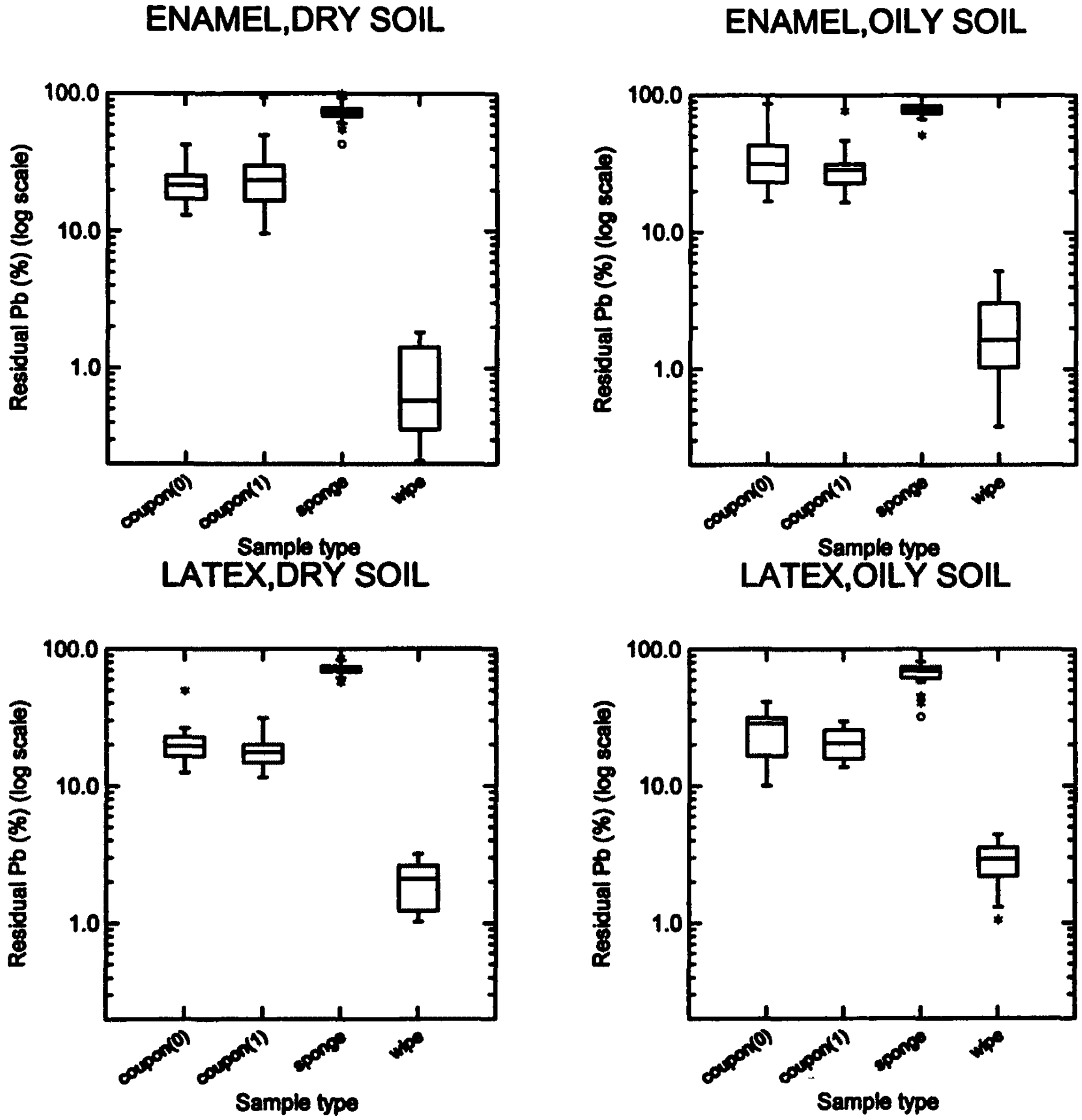
When lead-based paint/lead-based paint hazards are abated or interim controls are performed in a home, the contractor is required to clean the lead-contaminated dust. A surface is considered clean if the quantity of lead picked up by a baby wipe is below clearance levels. (The clearance levels from Chapter 5, Risk Assessment, of the 403 Guidance are 100 $\mu g/ft^2$ for carpets and hardwood floors, 500 $\mu g/ft^2$ for interior window sills, and 800 $\mu g/ft^2$ for window troughs. Lower clearance levels are presently being proposed that will present even more challenge to the cleaning process.) Risk assessors also perform wipe sampling of dust to determine if lead hazards are present in a home. The same approach was used in this laboratory study. Cleaning solutions that remove most of the lead will leave less lead to be picked up by the wipe. Therefore, for the most effective cleaning solutions, the quantity of lead picked up by a wipe and the quantity of lead remaining on the surface will be less than for other cleaning solutions.

Sixteen cleaning solutions were evaluated for their ability to clean two surface types soiled with two soil types. The effect of phosphate content and surface tension, and their interaction on cleaning efficacy was investigated. The percentage of lead removed by the sponge and the wipe and that remaining on the coupon surfaces (either wiped or not) was estimated for various experimental conditions. To be consistent with the terminology of the previous study,[1] the lead remaining on the coupon is called residual lead and is expressed as a proportion (or percentage) of the quantity of the lead on the coupon before cleaning. Similarly, the lead captured by the sponge and wipe is expressed as a proportion (percentage) of the lead on the coupon before cleaning. The distribution of these percentages is shown, on the log-scale, in the form of boxplots in Figure 2-1, separately for the four combinations of soil (dry and oily) and surface types (enamel- and latex-painted). [Note: Coupon(0) and Coupon(1) on the X-axis indicate sponge-cleaning only and sponge-cleaning and wiping, respectively.]

This section provides an overview of the study design and a discussion of conclusions.

2.1 Design

A commercially available hand dishwashing detergent (cleaning agent) was selected to assess the effect of surface tension on lead-cleaning efficacy of a standard sponge-cleaning procedure. (The reasons for choosing a hand dishwashing detergent are discussed in detail in Section 3.2.) The four surface tensions of 30, 40, 60, and 70 dyne/cm were approximated by mixing the four amounts of cleaning agent of 6.36, 0.050, 0.008, and 0 g, respectively, into 1 gallon of water. Surface tensions below 25 to 30 dyne/cm are difficult



Legend: coupon(0) indicates that the coupon <u>was not</u> wiped after sponge-cleaning
coupon(1) indicates that the coupon <u>was</u> wiped after sponge-cleaning

Figure 2-1. Distribution of Percentage of Lead Found in Sponges, Wipes, and on Coupons (Wiped and Not Wiped), by Surface and Soil Types (Log-scale)

to achieve for aqueous solutions, thus 30 dyne/cm was the lower limit of the range of surface tensions. Additionally, the effect of phosphate content on lead-cleaning efficacy was investigated by adding known amounts of anhydrous trisodium phosphate to the cleaning solutions corresponding to the amounts of 0, 3, 11, and 14 g phosphorus per gallon (g P/gal). The combination of these two factors provided 16 cleaning solutions to be tested.

Laboratory staff prepared two types of surfaces—enamel- and latex-painted birch plywood—each one foot square (called coupons), and placed lead-containing synthetic soil on the surfaces. The lead-containing synthetic soil was a modification of ASTM D4488 soil, replacing the clay in the ASTM D4488 soil with NIST SRM 2710 (5,532 μg Pb/g), a contaminated soil from Montana. The two surfaces selected for contamination with the soil were intended to represent all common types of surfaces to be cleaned (e.g., walls, trim, kitchen cabinets). Two types of soil were used. One contained a small amount of vegetable oil to simulate dust contaminated with oils from cooking or human contact. The other, a dry soil, contained no added oil.

The lead loadings used in the study correspond to approximately 950 μg Pb/ft^2 (dry soil on enamel-painted surfaces), 1,900 μg Pb/ft^2 (dry soil on latex-painted surfaces), 850 μg Pb/ft^2 (oily soil on enamel-painted surfaces), and 1,700 μg Pb/ft^2 (oily soil on latex-painted surfaces). To obtain a reasonably even distribution of soil over the majority of the surface on latex-coated coupons, 4 mL of soil mixture was necessary. Only 2 mL of soil mixture was required to obtain the same coverage result on enamel-coated coupons.

The coupons were soiled by a single technician according to a full factorial experimental design. A single technician then cleaned each coupon surface with a given cleaning solution using a sponge to remove the soil material and the associated lead. Half the coupons were then wiped using a baby wipe; the other half were not. (The wipes used were pre-wetted, commercially available baby wipes containing purified water and propylene glycol, as per manufacturer's ingredients list, to wet the wipes and keep them wet for a long period of time.) All coupons were then cored. All sponge, wipe, and core samples were analyzed to measure the amount of lead in each type of sample.

2.2 Conclusions

Based on the 128 sponge-cleaning tests, 64 wipe tests, 64 coupon tests from wiped surfaces, and 64 coupon tests from 64 non-wiped surfaces, the following conclusions were drawn.

- Approximately 72 to 74 percent of the lead applied was removed by the sponge.

- Approximately 1.3 to 1.6 percent of the lead applied was removed by the wipes after the surfaces were cleaned by the sponge.

- Approximately 20 to 23 percent of the lead applied remained on the coupons after sponge-cleaning and wiping.

- Approximately 22 to 26 percent of the lead applied remained on the coupons after sponge-cleaning only.

- The total percentage of lead accounted for in this study was estimated at approximately 95 to 99 percent, leaving approximately 0.9 to 5.3 percent unaccounted for.

The amount of lead picked up by the wipe from the sponge-cleaned surface was estimated at approximately 2 percent in the previous study. This estimate is comparable to the slightly lower estimate of 1.3 to 1.6 percent found in this study.

In contrast, the estimated amount of lead remaining on the cleaned surface, expressed in percentage of applied amount, is significantly higher in this study than in the previous study: 20 to 26 percent versus 7 percent. The estimate of 20 to 26 percent was directly estimated from cleaning tests in this study. Since neither sponges nor surface samples were analyzed in the previous study, the percentage of lead removed by a cleaner and sponge was based on a small set of wipe cleaning experiments. In that study, the assumption was made that two baby wipes would remove similar quantities of lead as would a cleaner and sponge. That estimate was found to be roughly 91 percent. By subtraction, the percentage of lead remaining on a cleaned and wiped surface was estimated at 100 percent - 91 percent - 2 percent = 7 percent.

The analysis of the effect of surface tension and phosphate content on cleaning efficacy provided the following results:

- Overall, surface tension and phosphate content had no statistically significant effect on the residual lead found on coupons. This is true whether the coupons were wiped or not after sponge cleaning.

- When sponge and wipe results were examined, both surface tension and phosphate content had an overall statistically significant effect on cleaning efficacy. However, no consistent pattern in the effect of these two factors on cleaning efficacy could be found. That is, no monotonic relationship could be found between the levels (values) of these factors and the resulting cleaning efficacy. This lack of consistent pattern was found in sponges and wipes. For example:

  - Across all coupon surface types, soil types, and phosphate content levels, it was found that lower surface tension cleaning solutions are associated with better sponge cleaning. However, this significant surface tension effect is masked by interactions with the type of coupon surface and soil type.

- When looking individually at the four combinations of surface type and soil type, surface tension was no longer predicting cleaning efficacy when using a sponge.

- Only when dry soil was applied to latex-painted surfaces did phosphate content affect cleaning efficacy when a sponge was used. However, no meaningful relationship between cleaning efficacy and phosphate content level could be found. In other words, cleaning efficacy did not increase or decrease consistently with phosphate content.

- Surface tension had a small but significant effect on the ability of wipes to pick up lead from all surfaces. It was found that the percentage amount of lead picked up by the wipe increased with increasing surface tension of the cleaning solution.

The effect of surface type and soil type on cleaning efficacy was also investigated. The analysis provided the following results:

- Surface type (enamel- and latex-painted plywood surfaces), soil type (dry and oily), and their interaction had in most cases a significant effect on lead cleaning efficacy.

- Although latex-painted surfaces are rougher than enamel-painted surfaces, the percentage of lead found in the sponge did not reflect that fact. However, wipes picked up a higher percentage lead from latex-painted surfaces than from enamel-painted surfaces after sponge-cleaning, possibly indicating that rougher surfaces are more difficult to clean.

- The above finding could not be confirmed when looking at the residual lead on the coupons. In those cases (wiped and non-wiped coupons), the trend was counter-intuitive in that a higher residual lead was found on enamel- (smooth) than latex- (rough) painted surface.

- Generally, an oily soil surface was more difficult to clean than a dry soil surface.

2.3 Recommendations

Based on the above findings, no conclusive evidence was found to recommend trisodium phosphate (TSP) or high phosphate detergent cleaners for lead removal inside homes. In addition, the weak evidence found in the previous study that cleaners with lower surface tension appear to clean soiled surfaces slightly better than cleaners with high surface tension could neither be refuted nor strengthened. However, EPA still recommends that either a general all-purpose cleaner or a cleaner made specifically for lead should be used for both general cleaning and for post-intervention cleaning. Household cleaning

using one of these cleaning agents is likely to remove more leaded soil and dust than does water alone.

The extent to which these conclusions, based on laboratory investigation, apply to homes in real-life situations is a matter of judgment. Cleaning home interiors with a damp sponge or cloth will likely remove significant amounts of lead-containing soils. Water alone would do an adequate job, but considering that most cleaning is done by repeatedly wiping a soiled surface and rinsing the sponge or cloth into a bulk cleaning solution, a common household cleaner would probably help keep the soil in suspension, thus lessening the redeposition of the soil back onto the surface being cleaned. General home cleaning will thus further assist in the prevention of childhood lead poisoning.

Section 3
Study Design

This section provides the overall study design, including the selection of the cleaning agent, the tests performed, and the number of tests and their randomization.

3.1 Experimental Design

The experimental design for this follow-up study was based on statistical results from the previous study. Most factors considered here are identical to those investigated in the previous study, with the exception of the number of cleaners and substrates. As before, baby wipes were used to wipe the coupons after they were cleaned with a sponge and the cleaning mixture. However, unlike in the previous study, the sponges, cleaning solutions, and rinse water were not discarded, but were analyzed for lead content. In addition, core samples of each coupon were taken, composited, and also analyzed for residual lead. It was further decided to perform two sets of tests as follows:

- In one set of experiments, the coupons were soiled, then cleaned with the sponge plus cleaning solution plus water, and then wiped with baby wipes.
- In the other set of experiments ("replicate" runs), the coupons were soiled, then cleaned with the sponge plus cleaning solution plus water. These coupons were not wiped with baby wipes so that the number of wipe lead analyses was reduced in an attempt to control cost and because the previous study already provided ample information on lead content of wipes.

In summary, based on discussions among EPA and project staff, the previous lead-cleaning efficacy results, and the objectives of this follow-up study, the following design factors were considered in a full factorial experimental design:

- A hand dishwashing detergent at 4 concentration levels corresponding to 4 surface tension values of approximately 30, 40, 60, and 70 dyne/cm
- Anhydrous trisodium phosphate (TSP) concentration levels corresponding to approximately 0, 3, 11, and 14 grams of phosphorus per gallon (g P/gal)
- 2 substrates: enamel on birch plywood and latex on birch plywood
- 2 soils: oily and dry
- Replication of tests

This design layout resulted in a total of 4 surface tensions x 4 phosphate levels x 2 substrates x 2 soil types x 2 replications = 128 coupon tests. Under this scenario, two batches of soil mixture of each type of soil needed to be prepared because a single batch of soil mixture is sufficient for only 40 coupon tests, adding a blocking factor to the design and the sequence of tests. From this design, a test schedule was developed as follows. The first soil batch consisting of 8 oily mixtures and 8 dry mixtures was prepared (at the same time, as in the previous lead-cleaning study). Then half of the first set of tests (with wiping) and half of the second set of tests (without wiping) was completed. After these 64 coupon tests were completed, the second soil batch, again consisting of 8 oily mixtures and 8 dry mixtures, was prepared for the remaining coupon tests. Each cleaning solution was used on 4 coupons (4 combinations of 2 soil types and 2 substrates).

All tests were performed on new coupons; that is, new birch plywood was painted with either latex (1 coat of primer and 1 top coat of paint) or enamel (2 top coats of paint) paint and cut into 12 in x 12 in coupons (the thickness of the dried paint film is unknown). The same procedures for coupon preparation, soil mixture preparation, soil mixture application, and coupon cleaning as were used in the previous study were followed. The procedures for preparing the cleaning solutions and coring the coupons are explained in Section 4.1. Samples were analyzed for lead according to the QAPjP for Pb-Cleaning Efficacy for Lead Abatement in Housing, Revision No. 4, July 12, 1995.[2] Additional protocols developed to address the modified digestion procedures of sponge and core samples can be found in Appendices B-1 and B-2, respectively, of the above mentioned QAPjP.[3,4] These appendices reflect the changes made to Appendix B in its terminology (sponge and core, respectively, instead of wipe) and in the volume of acid needed to digest the samples that were larger in weight than wipe samples.

The test schedule based on this design is shown in Table A-1 in Appendix A. The sequence of the cleaning solutions (combinations of surface tension and phosphate content) was randomized within soil batch, and the sequence for the coupon tests (soil and substrate) was randomized within cleaning solution. This design required the preparation of 32 cleaning solutions, each of a given surface tension (4 levels) and phosphate content (4 levels), in duplicate. A total of 128 coupons (32 cleaning solutions x 2 soil types x 2 substrates) were prepared, soiled, and cleaned. Of these 128 coupons, 64 were cleaned

Table 3-1. Number of Cleaning Solutions Tested for Each Combination of Phosphate Content and Surface Tension

Phosphate content (g P/gal)	Surface tension (dyne/cm)				
	30	40	60	70	All
0	2	2	2	2	8
3	2	2	2	2	8
11	2	2	2	2	8
14	2	2	2	2	8
All	8	8	8	8	32

with a sponge + cleaning solution + water. The remaining 64 coupons were cleaned with a sponge + cleaning solution + water and also wiped with baby wipes. The total number of cleaning solutions tested for each combination of phosphate content and surface tension in this design is shown in Table 3-1.

3.2 Cleaning Agent Selection

A total of 32 commercially available cleaning agents, synthetic tap water of average hardness, and TSP were tested in the previous study. From the 32 cleaning agents, a single cleaner (a popular, commercial hand dishwashing detergent) was selected. The criteria for selection were that the cleaner be:

- a phosphate-free cleaner, because TSP will be added to the cleaning solutions at various concentration levels.
- a neutral to basic cleaner so as to avoid mixing an acidic cleaner with TSP (basic).
- a cleaner that does not need to be used at full strength, such as out of a squirt bottle; such a cleaner would not allow the consumer to adjust concentration to change surface tension.
- a cleaner that is easily measured out, that is, in a significant amount to be added to water (e.g., 1/2 gal). This criterion excluded laundry and dishwashing cleaners since they are used in small amounts in larger quantities of water.
- a cleaner that is readily available in households, such as a hand dishwashing cleaner.

3.3 Precleaning Tests

To verify some of the results found in the previous study pertaining to the lead levels in the soil mixtures and the rod rinse,[1] a small number of tests were performed without cleaning solution. Based on the above experimental design, verification tests, including soiling and wiping the coupons with two baby wipes each, were performed on a total of:

- 2 soil mixtures x 2 batches of each soil mixtures x 2 substrates = 8 coupons

Core samples of these coupons were also taken, although this step was not performed in the previous study. Samples were taken and analyzed by either ICP or GFAA for lead content as follows:

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[1]The rod rinse is a mixture of a solvent and the soil left on the applicator rod after it was used to spread the soil on the coupon. See Section 4.1 for details of soil application procedure.

- 8 soil mixture samples (2 types of soil mixture x 2 batches of soil mixture each x 2 replications)
- 8 coupon core samples (4 enamel on birch and 4 latex on birch coupons)
- 8 rod-rinse samples (1 per coupon)
- 16 wipes (2 wipes per coupon)

These eight precleaning tests were randomly inserted in the design layout shown in Table A-1 in Appendix A as follows. Precleaning tests using a given soil batch (1 or 2) were performed when that soil batch was used for the coupon tests. In addition, the precleaning tests were always performed between two sets of tests using different cleaning solutions for ease of implementation. Except for these two restrictions, the placement of the precleaning tests was random within the sequence of the 128 coupon tests. Table 3-2 summarizes the combination and sequence of precleaning tests.

Table 3-2. Test Schedule of Proposed Precleaning Tests

Soil batch	Soil type	Substrate	Test sequence
1	Oily	Enamel	1
1	Oily	Latex	2
1	Dry	Latex	3
1	Dry	Enamel	4
2	Dry	Latex	5
2	Dry	Enamel	6
2	Oily	Enamel	7
2	Oily	Latex	8

3.4 Blank Soil Tests

As was done in the previous study, a limited number of tests with "blank soil," that is, using soil without the leaded component, were performed to identify the magnitude and source of any contamination. A total of eight coupon tests, requiring the preparation of both oily and dry blank soil mixtures, were performed using cleaning solution Nos. 16 and 32 according to the test schedule shown in Table 3-3.

Table 3-3. Test Schedule of Blank Soil Tests

Soil type	Phosphate level	Measurement method	Substrate	Surface tension	Cleaning solution	Test sequence
Oily	0	No wipe	Enamel	30	16	1
Dry	0	Wipe	Enamel	30	16	2
Dry	0	Wipe	Latex	30	16	3
Oily	0	No wipe	Latex	30	16	4
Dry	11	No wipe	Latex	30	32	5678
Oily	11	Wipe	Enamel	30	32	
Dry	11	No wipe	Enamel	30	32	
Oily	11	Wipe	Latex	30	32	

Samples were taken and analyzed for lead content by ICP followed by GFAA, if necessary, as follows:

- 8 coupon core samples (4 enamel on birch, 4 latex on birch)
- 8 sponge + cleaning solution + water (1 per coupon)
- 4 wipe samples (1 per coupon, if wiped)

Table 3-4 summarizes the number and types of field samples that resulted from this experimental design. Throughout this report, samples generated by the coupon preparation laboratory are referred to as field samples. In contrast, samples generated in the analytical laboratory, such as method blanks, standard reference material samples, and laboratory control samples, are referred to as laboratory QC samples. A slight deviation from this classification is that matrix method blanks, such as blank wipes, blank sponges, and blank cores, although generated in the coupon preparation laboratory, are included with the laboratory QC samples.

Table 3-4. Summary of Field Samples Generated

Type of sample	Precleaning tests	Blank soil tests	Cleaning tests	All
Soil mixture	8	0	0	8
Rod rinse	8	0	0	8
Coupon	8	8	128	144
Sponge + cleaning solution + water	0	8	128	136
Wipe	16	4	64	84
All	40	20	320	380

Section 4
Laboratory Data Collection

The cleaning tests were performed according to the experimental design described in Section 3.1 and the test sequence shown in Table A-1 in Appendix A. Precleaning and blank soil tests were included as discussed in Sections 3.3 and 3.4. Both the preparation work for the coupons and the analytical lead work were performed by the same contractor as that reported in the previous lead-cleaning efficacy study. The following sections summarize the two types of data collection procedures, referred to as test data collection and quality control data collection procedures.

4.1 Test Data Collection

A single technician implemented all laboratory procedures according to protocols. The protocols were those followed in the previous study and are included as part of the "Quality Assurance Project Plan for Pb-Cleaning Efficacy for Lead Abatement in Housing, Revision No. 4."[2]

Soil Mixture Preparation: Two types of soil were prepared following the same recipes as in the previous study: one soil mixture contained vegetable oil (oily soil), while the other mixture did not (dry soil). Each soil mixture consisted of 15 g of Standard Reference Material (SRM) 2710, a lead-containing soil with a concentration of 5,532 µg/g, as reported by NIST, 7.5 g of Norit A carbon black, 150 mL of mineral spirits, and 6.75 g of vegetable oil (oily soil only). Blank soils consisted of carbon black and mineral spirits, with the addition of vegetable oil for the oily blank soil. [Note: The boiling point of mineral spirits is 179° to 210°C; however, mineral spirits is a fairly volatile liquid. Mineral spirits was used in this study as a carrier to make the soil fluid so that it could be spread over the coupons. Vaporization of the mineral spirits was kept to a minimum by keeping the lid of the container tightly closed. A hole, just large enough to pass the pipette through it, was drilled through another lid. That lid was used while pipetting the soil mixture.]

Cleaning Solution Preparation: The 16 unique cleaning solutions (4 phosphate levels and 4 surface tensions) required for the study were prepared in two batches each. The four target phosphate levels were achieved by adding anhydrous trisodium phosphate in amounts corresponding to concentrations of 0, 3, 11, and 14 g of phosphorus per 1 gal of cleaning solution. The phosphate content was calculated as phosphorus (P) contained in reagent grade anhydrous trisodium phosphate. The four surface tensions were obtained by adding approximately 0, 0.008, 0.050, and 6.36 g of the cleaning agent to 1 gal of synthetic hard water corresponding to the nominal surface tension levels of 70, 60, 40, and 30 dyne/cm, respectively. Once the cleaning solutions were prepared (i.e., after the

addition of phosphate), their surface tension was measured twice per ASTM D1331, prior to cleaning the coupons.

Coupon Preparation: A total of 152 coupons were prepared at the onset of the study. All coupons were made of birch plywood; half were painted with enamel paint and half with latex paint. (The painted material from which the coupons were made is referred to as the substrate.) Of the 152 coupons, 136 were soiled with leaded soil, including 128 test coupons plus 8 coupons for precleaning studies; 8 were soiled with blank soil (i.e., the soil contains no lead); and 8 were used as matrix method blanks (i.e., the coupons were analyzed as is).

Soil Application: The leaded soil was spread over a coupon using an applicator rod, following the procedures described in the QAPjP.[2] The applicator consisted of a 0.010-in diameter stainless steel wire wrapped around a 3/8-in diameter stainless steel rod. The rod was wrapped with wire over a 13-in length. A vee was produced between each wrap of the wire so that liquid would escape through the vee. A bead of liquid soil was spread across the coupon. The applicator rod was then repeatedly moved back and forth across the face of the substrate coupon to spread the liquid soil material as uniformly as possible over an area of approximately 10 x 10-in square. The rod was not allowed to roll on the substrate coupon surface to minimize the amount of soil retained on the applicator rod. The applicator rod was always parallel to the grain direction of the substrate coupon. Figure 4-1 provides a diagram of the soil application process.

Coupon Cleaning: The soiled coupons were first cleaned using a new 3/4-in x 3-in x 6-in cellulose sponge to which the cleaning solution had been applied, according to the cleaning protocol. Following the cleaning with the sponge, the coupon was dried, then wiped with a single baby wipe according to the HUD Guidelines method. The sponge with its cleaning solution and water was kept for chemical analysis. Note that according to the study design, only half the coupons were wiped after cleaning. The wipes were also kept for chemical analysis.

Coupon Coring: Coupon samples were taken for chemical analysis to quantify the amount of lead remaining on the surface of the coupon after cleaning and wiping. Nine core samples were taken from each coupon as shown in Figure 4-2. The core samples were generated by using a 1/2-in diameter wood-coring drill bit. The coring drill bit was designed to score the coupon at the circumference of the drill bit to reduce the generation of splinters outside the 1/2-in diameter core sample area. The coupon was scored first on both plane surfaces, then drilled through. After each drilling, the coring drill bit was brushed off to remove and collect adhering soil, paint, and plywood. The painted wood chips were collected and kept for chemical analysis.

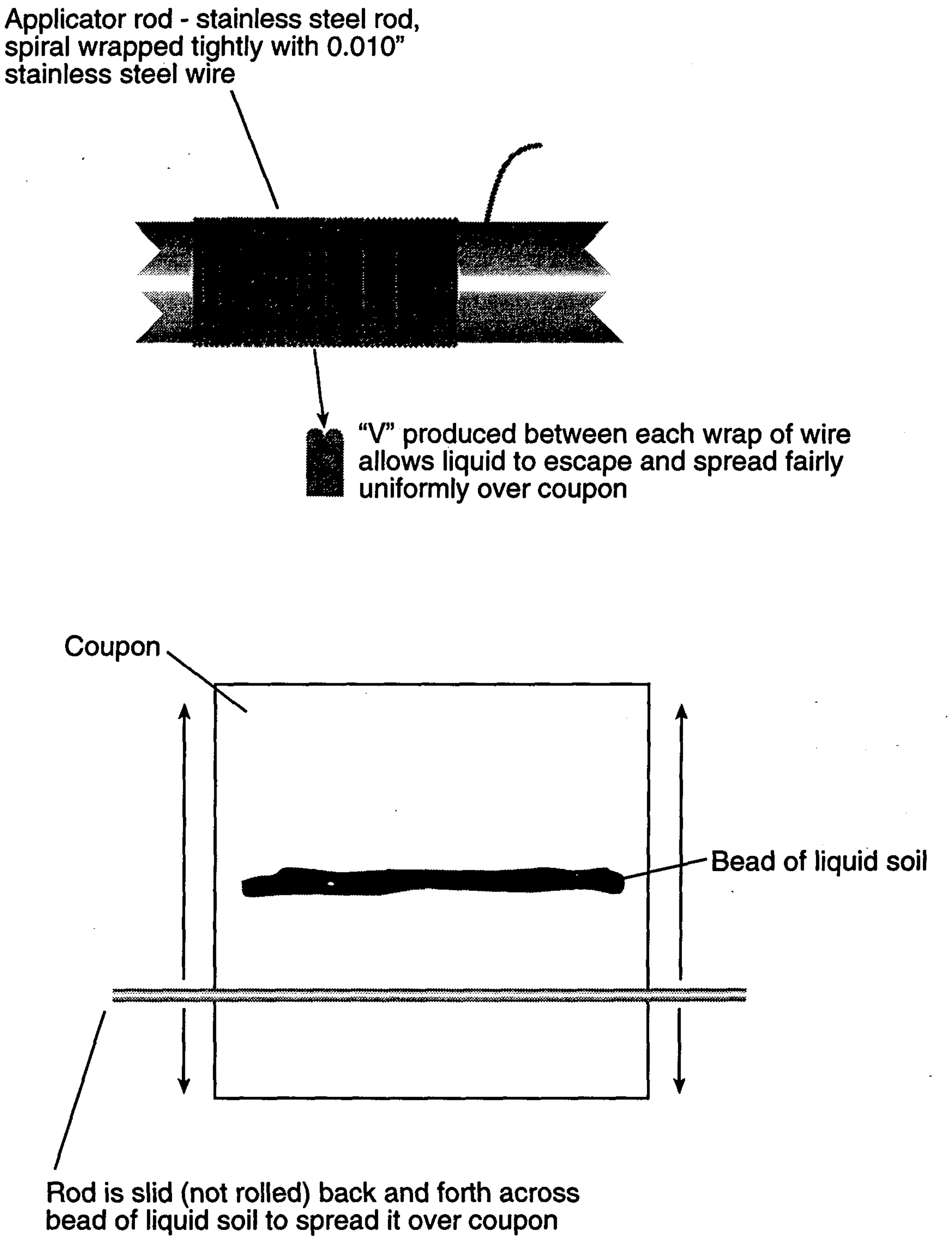


Figure 4-1. Diagram of Soil Application Procedure

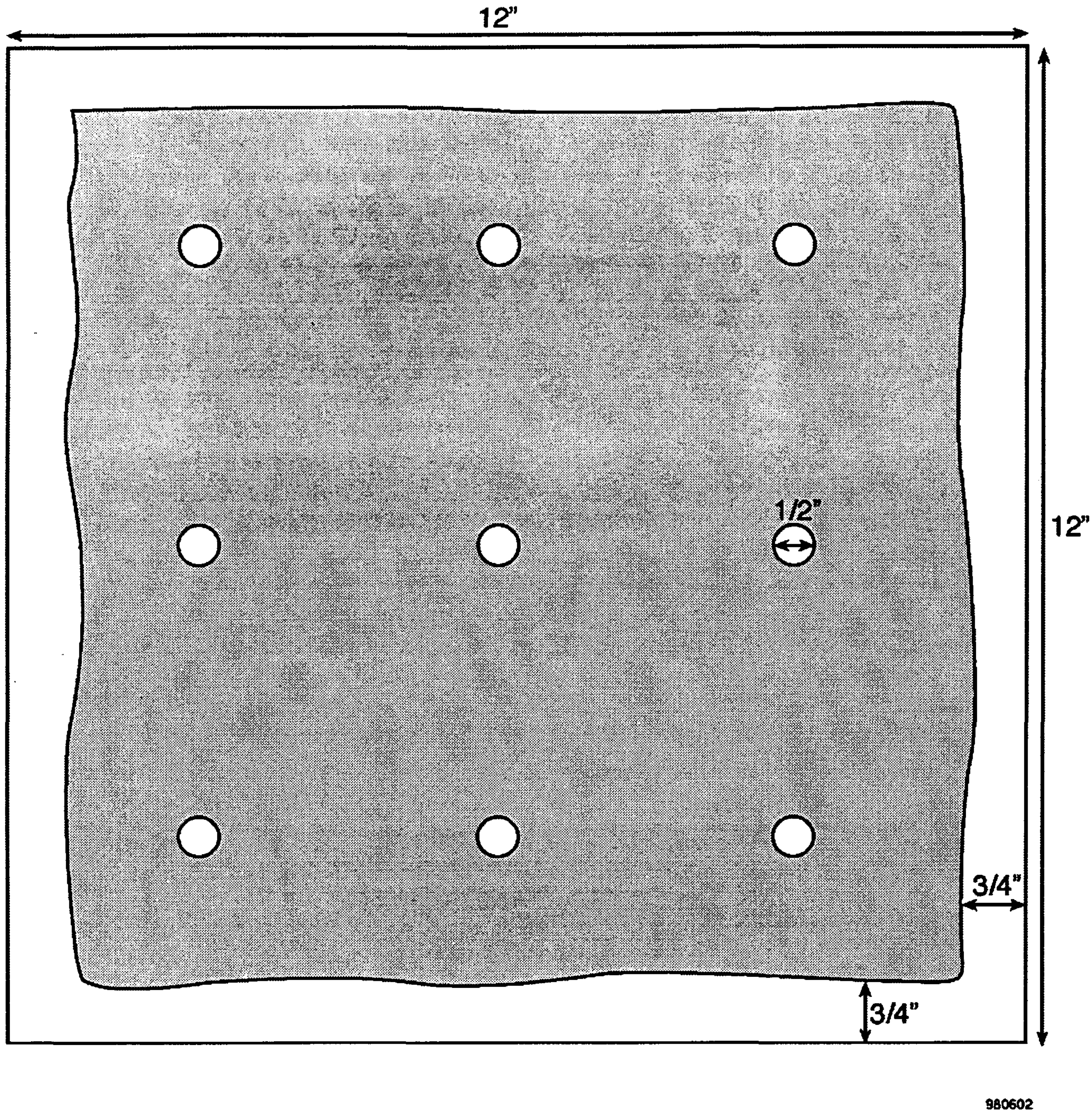


Figure 4-2. Diagram of Core Hole Locations on Coupon

To estimate the average surface of the drilled cores, an estimate of the average diameter of the holes was obtained as follows. The diameter of three randomly selected holes in seven randomly selected coupons was measured. The 21 diameters ranged between 0.5095 in and 0.5250 in, with a mean of 0.5148 in and a standard deviation of 0.0051 in. Thus, the average surface of the 9 holes per coupon was calculated at 1.8736 in^2, representing only a small fraction of the coupon surface. Furthermore, when soiling a coupon, the soil was applied to the entire 12-in^2 coupon minus approximately a 3/4-in border. It is therefore assumed that the soiled surface is approximately 110.25 in^2. However, since both sponging and wiping activities were performed over the entire surface of the coupon (i.e., 144 in^2), it is assumed that the residual lead on the coupons is evenly spread over the entire surface. To obtain an estimate of the amount of lead remaining on the coupon (actually on the soiled surface of the coupon), the results from the composited nine core samples were adjusted upward to the soiled surface of the coupons. The final Pb result were thus expressed in total µg of Pb per coupon. The correction factor applied to the core sample Pb results was thus estimated at 76.86 (144/1.8736) and was applied to all core sample results in this study.

Precleaning Tests: According to the study design, eight separate tests were performed to measure the quantity of lead applied to the coupons before cleaning (Section 3.3). For these precleaning tests, the leaded soil (oily and dry, one from each soil batch) was applied to the coupons (latex and enamel substrates) using the applicator rod according to the procedures used in all cleaner tests. The applicator rod was then rinsed and the rinsate, or rod-rinse sample, kept and analyzed for lead content. In addition, samples of the dry and oily soils were analyzed for lead content. The quantity of lead in the soil and that in the rod rinse provided an estimate of the quantity of lead applied before cleaning. The coupons soiled during these tests were wiped with two wipes and subsequently cored. No cleaner was used in these tests.

Blank Soil Tests: Eight blank soil tests were performed using one cleaning solution from each batch and two coupons of each of two types. These tests are similar to the cleaner tests except that the soil applied to the coupons did not contain lead. These tests were performed to assess potential contamination during testing activities.

Matrix Method Blanks: To assess potential lead contamination during the preparation steps of the coupons, a number of blank samples were collected: 7 blank sponges, 5 blank wipes, and 8 blank core samples. These samples were inserted into the analytical preparation batches and analyzed along with the test samples.

Cleaner Phosphate Content and Surface Tension Measurements: The 32 cleaners, prepared in two sets, were obtained by mixing known amounts of the cleaning agent into a known amount of synthetic hard water to approximate the four surface tensions of 30, 40, 60, and 70 dyne/cm specified in the experimental design. Synthetic hard water, chosen in consultation with EPA/OPPT, was prepared according to ASTM D4488. The average hardness across U.S. cities is near 150 ppm as calcium carbonate, the hardness of the

prepared water. To each solution, anhydrous trisodium phosphate was then added as specified by the design to achieve the four phosphate content levels corresponding to 0, 3, 11, and 14 g P/gal. Two surface tension measurements were taken from each of the 32 cleaning solutions (4 phosphate content x 4 surface tension x 2 batches), and then averaged. Phosphate content was calculated as grams of phosphorus/gallon, since reagent grade trisodium phosphate, anhydrous, was used as the phosphorus source.

4.2 Quality Control Data Collection

All test samples (soils, rod rinses, sponges, wipes, and cores) were sent to the analytical laboratory for lead analysis. The test samples were digested in batches of 20 with additional quality control samples as required in the QAPjP and according to the Modified EPA Method 3050A used in this study. The wipe digestion method in the QAPjP required additional modifications to accommodate the sponge and core samples because they exceeded the 2-g sample weight limit of the method. Additional protocols were developed addressing the digestion of sponge and core samples and added to the QAPjP.[3,4] An aliquot from each sample digest was analyzed for lead by inductively coupled plasma atomic emission spectroscopy (ICP) using modified EPA Method 6010A. Samples, which had a concentration less than ten times the ICP instrument detection limit, were analyzed using graphite furnace atomic absorption spectroscopy (GFAA) using a modified EPA Method 7421. A total of 1,321 lead analyses was performed for this study. Table 4-1 summarizes the number of samples of each type generated, separated by analytical method.

Table 4-1. Type and Number of Samples by Analytical Method

Sample type	Analytical method ICP	Analytical method GFAA	Total
Test Samples			
Rod rinse	8	2	10
Sponge	136	6	142
Wipe	86	56	142
Core	144	144	288
Soil	8	0	8
Matrix method blank (MMB)	21	16	37
Total	**403**	**224**	**627**
Percent (%)	64.3	35.7	100
Quality Control Samples			
Laboratory control sample (LCS)	20	15	35
Method blank (MB)	21	16	37
Standard reference material (SRM)	22	2	24
Total	**63**	**33**	**96**
Percent (%)	65.6	34.4	100
Instrument QC samples	393	205	598
Grand total	**859**	**462**	**1,321**
Percent (%)	65.0	35.0	100

Section 5
Quality Assurance/Quality Control

An evaluation of the sample preparation and analysis results was performed throughout the course of the data collection by the Atomic Spectroscopy Facility Group Leader and by the program QA Officer (QAO). After final data reduction, an independent evaluation of the results was performed under the direction of the QAO. The final QC data were statistically analyzed by the project statistician. The results are presented in the following subsections.

5.1 Quality Assurance

A complete systems audit was performed on this Work Assignment. The system audit consisted of in-phase audits, facility audits, data audits, and a review and verification of the final report. The performance of the analytical system used for this Work Assignment was assessed using the results from the NIST SRM. The results of the performance assessment are discussed below in Section 5.2 under the Standard Reference Material topic.

Sample identification and calculated lead amounts and recovery results are shown in Appendix B. These data pertain to all QC samples as well as all test samples generated during the project. The hard copy and computer records for the work performed by the contractor laboratory, including the tables for the final report, were audited. All sample identification codes and data were verified throughout the data handling process. The items verified during the audit are listed below.

- Accuracy and completeness for 15 data packets.

- Completeness, compliance, and accuracy of the laboratory notebook pages, including the method of analysis, the project number, date of analysis, the analyst's name, the standards used for calibration, the steps performed in the preparation of the standards, and the dilutions.

- Accuracy of the value used for NIST SRM 2710, based on the Certificate of Analysis information.

- Accuracy of the sample identification codes in the report tables, using the sample preparation inventory listing from the test design.

- Accuracy of the instrument responses presented as µg/mL for ICP and ng for GFAA in the data calculation tables, using the instrumental raw analysis data.

- Accuracy of the initial calibration verification (ICV) control charts, using the percent recovery results from the data calculation tables, separately for ICP and GFAA.

- Accuracy of the initial laboratory control sample (LCS) control charts, using the percent recovery results from the data calculation tables, separately for ICP and GFAA.

- Accuracy of the SRM 2710 control charts, using the percent recovery results from the data calculation tables, separately for ICP and GFAA.

All QC data were inspected in real time as they were collected and were reduced the following day. The problems found during this data audit were addressed in a letter to the EPA Work Assignment Manager and are discussed in the following section.

5.2 Quality Control

This section presents the analysis of the lead levels found in the QC samples analyzed with the test samples. Three types of laboratory QC samples and one type of test QC samples were analyzed by ICP and GFAA according to the QAPjP.[2] The QC samples included:

- 21 method blank (MB) samples, used to demonstrate absence of laboratory and reagent contamination

- 21 laboratory control samples (LCSs), used to monitor method performance and matrix effects

- 22 standard reference material (SRM) NIST 2710 samples, used to measure the effectiveness of the digestion and analysis methods

- 21 matrix method blank (MMB) samples, generated during the process of soiling and cleaning the coupons, to assess lead contamination during the coupon cleaning process and to determine background levels in each matrix type: sponge, wipe, coupon, and liquid soil

Method Blank (MB) Samples: In this study, two types of method blanks were prepared with each batch of samples: a method reagent blank (MB) and a matrix method blank (MMB). Both types of blanks are used to measure the extent of contamination problems associated with sampling, digestion, and analysis. The MB is used to measure the background levels of the reagents used for digestion plus any cross-contamination that might occur during the digestion procedure. The MMB is used to assess the background levels in the collection material, background levels in the reagents, and any cross-contamination that might occur during the digestion process.

Twenty-one laboratory-generated MB samples were prepared with the test samples. Five of the 21-MB results are reported from ICP and the remaining 16 results are from GFAA. All of the MBs reported by ICP were less than three times the instrument detection limit. Four of the 16 GFAA MB samples had lead levels less than the detection limit (0.19 µg Pb/wipe or 0.06 µg Pb/core). Lead levels in the MB ranged from 0.06 to 26.8 µg. The MB result of 26.8 µg was considered an outlier after performing a Dixon Outlier test for the GFAA wipe MB results. Excluding the outlier, the average GFAA lead level found in the remaining 15 MBs analyzed by GFAA was 0.84 µg with a standard deviation of 0.92 µg.

For a method blank to be acceptable for use with the accompanying samples, the concentration of the analyte of concern should not be higher than five percent of the measured concentration in the samples. In the wipe batch that contained an MB with an elevated lead background level, 8 of the 20 test samples prepared could be considered as having some background contamination. In this study, two types of method blanks (MB and MMB) were prepared with each batch of test samples to measure the extent of a contamination problem. The MMB is a more comprehensive measure of the background level than the MB because the MMB contains both reagents and matrix. The MMB prepared with this batch of wipes had a lead background less than detection limit and does not indicate significant lead background levels in the reagents, collection materials, or digestion procedure. Based on the background level for the MMB, the results for the test samples in this wipe batch should not be considered compromised.

Laboratory Control Samples (LCSs): An LCS is a blank sample, spiked with a known amount of analyte being measured and digested along with the other samples in a batch. The LCS is used to monitor the method performance in the presence of a matrix. An LCS is prepared by spiking the analyte on a blank matrix being investigated. LCSs were prepared by spiking an MMB with 100 µg of lead (from a NIST-traceable solution) for a final digestion concentration of 1 µg/mL. Twenty-one LCSs (9 core, 6 sponge, 5 wipe, and 1 liquid soil) were analyzed, and the percent recoveries calculated. The results shown here use the GFAA recovery results from the core LCSs and ICP recovery results from the other three LCS matrices.

One wipe LCS had a low recovery of 3.44 percent. This LCS was not spiked according to the procedure. This sample was determined to be an outlier using the Dixon's Outlier Test when compared with the wipe LCS results prepared and analyzed for this study. The poor performance for this LCS does not affect the results for the batch. In this program, two types of LCS samples were prepared and analyzed with each batch of samples, an aqueous spike and an SRM. The result for the SRM associated with this batch of wipe samples had a recovery of 102.6 percent.

LCS percent recovery statistics are summarized in Figure 5-1 in the form of a QC chart and in Table 5-1. Excluding the outlier of 3.44 percent, two of the remaining results are below the lower control limit of 80 percent.

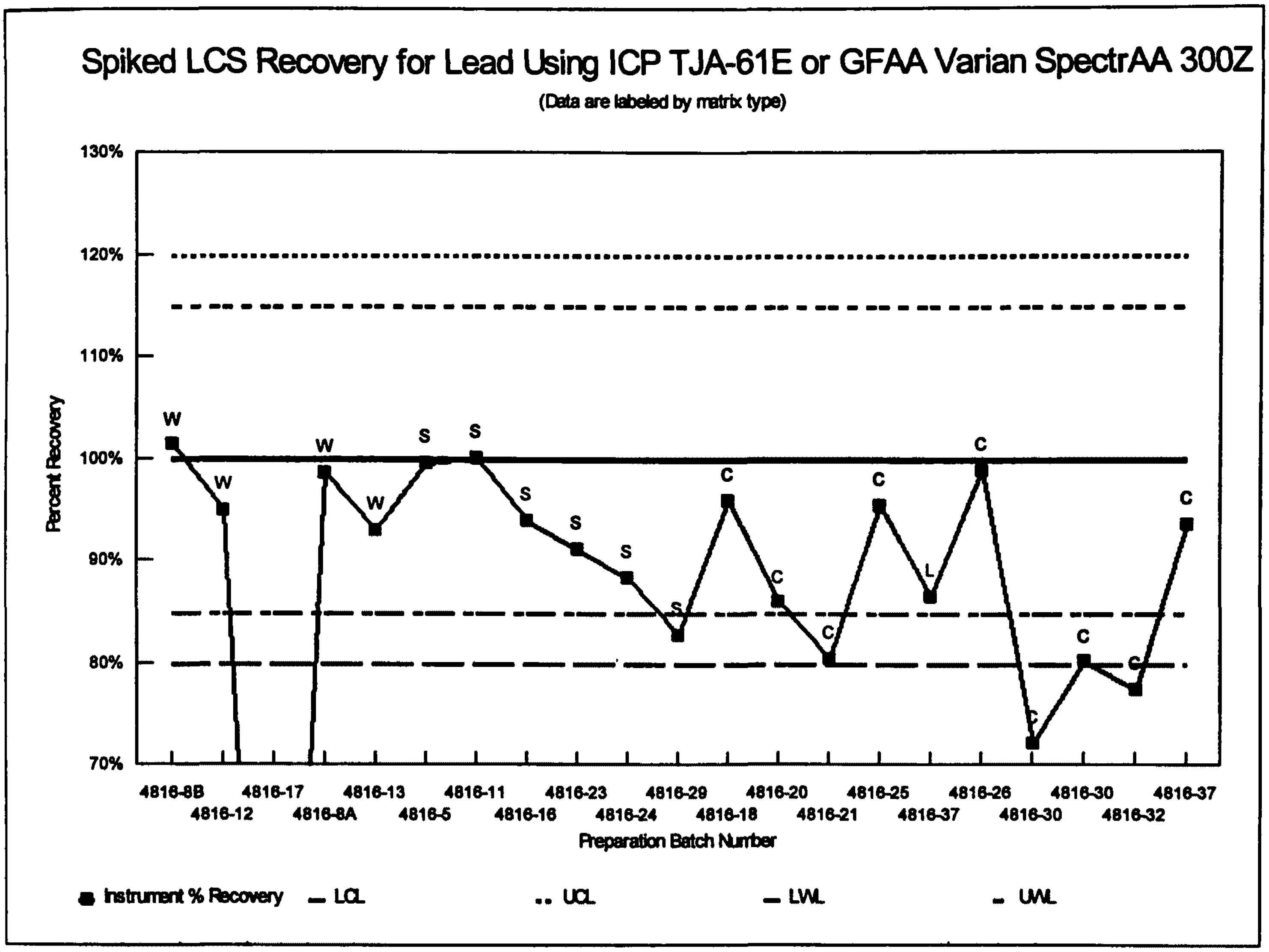
Table 5-1. Laboratory Control Sample Results by Matrix

Matrix (Instrument)	No. of samples	Percent recovery			
		Minimum	Maximum	Mean	Standard deviation
Core (GFAA)	9	72.3	99.0	86.8	9.61
Sponge (ICP)	6	82.8	100.1	92.7	6.68
Wipe (ICP)	4[a]	93.1	101.4	97.0	3.69
Liquid soil (ICP)	1	86.6	–	–	–

[a] One outlier of 3.44 percent removed.

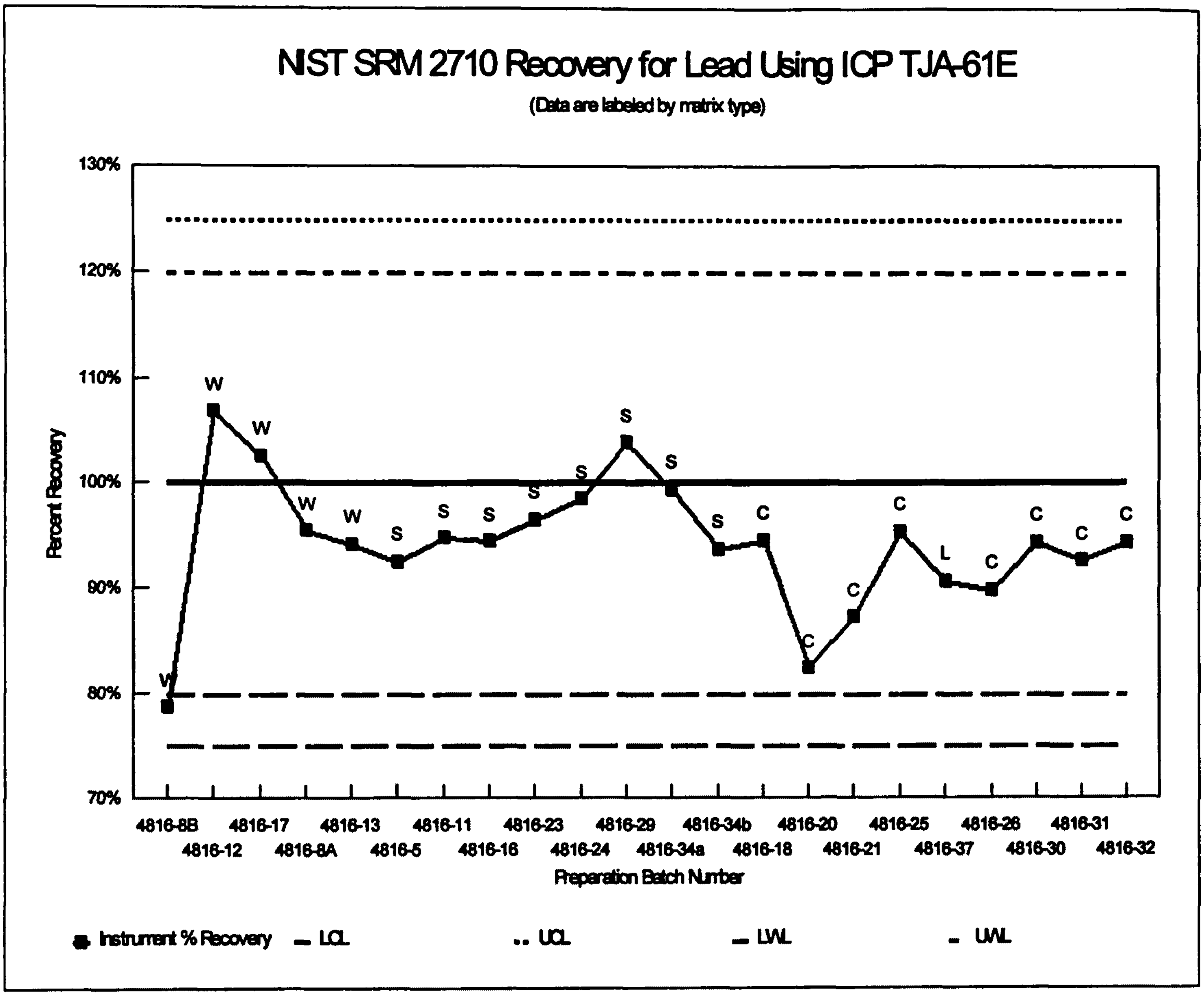
The LCS acceptance criteria stated in the QAPjP[2] are 80 percent to 120 percent recovery of Pb from the matrix. In this study, all of the LCS samples prepared with a sample matrix had acceptable recoveries and fell within the acceptance criteria for the LCS except for two core LCS samples. The core LCS samples had a lower mean value than the other matrices analyzed, which suggests that this matrix interferes with the recovery of Pb. The lowest value for the nine LCS samples prepared and analyzed was 72.3 percent. This recovery is within 1.5 times the standard deviation for this matrix type. When setting up control limits using the mean and the standard deviation for the core matrix, 72.3 percent recovery is in control, and all data should be accepted.

Standard Reference Material (SRM) Samples: SRM samples were tested to monitor variations in the data from one analytical batch to another and to estimate method recovery for the analytical process. These tests were performed in an ongoing fashion in the laboratory and were not project specific. NIST SRM 2710 with a lead level of 5,532 µg Pb/g material was used to prepare the leaded soils in this study, and a 1-g aliquot of the same SRM was used in the preparation laboratory. Twenty-two SRM samples (8 core, 8 sponge, 5 wipe, and 1 liquid soil) were analyzed, and the resulting percent recovery calculated. SRM percent recovery statistics are summarized in Figure 5-2 in the form of a QC chart and in Table 5-2. Of the 22 recovery results, one wipe SRM at 78.7 percent was below the lower warning limit of 80 percent but above the lower control limit of 75 percent.



Labels: W = Wipe; S = Sponge; C = Core; L = Liquid soil

Figure 5-1. LCS Percent Recovery Control Chart



Labels: W = Wipe; S = Sponge; C = Core; L = Liquid soil

Figure 5-2. SRM Percent Recovery Control Chart

Table 5-2. Standard Reference Material Results by Matrix

Matrix	No. of samples	Percent recovery			
		Minimum	Maximum	Mean	Standard deviation
Core	8	82.4	95.4	91.1	4.44
Sponge	8	92.6	103.9	96.7	3.71
Wipe	5	78.7	106.9	95.6	10.8
Liquid soil	1	90.7	–	–	–

All of the SRM results were within the acceptance criteria of the QAPjP. The data presented in Table 5-2 show that the results for all SRMs were within two standard deviations of the mean based on the matrix type. The good recoveries for the SRM suggest that the reported data for each matrix type is comparable to other batches of similar matrix that were digested and analyzed.

Matrix Method Blank (MMB) Samples: Blank sponge, wipe, and core samples were used to determine the background levels, if any, in the materials used. One blank sponge, core, or wipe sample was included in each preparation batch according to matrix type. A total of 21 MMBs were analyzed by ICP (9 core, 7 sponge, and 5 wipe samples). Of the 21 MMBs, only five sponge batches are reported from ICP data in Table 5-3. The remaining 16 MMBs are taken from GFAA data because samples in the batch were less than 10 times the ICP instrument detection limit, necessitating analysis by GFAA. Two blank sponges showed high levels of lead: one at 25.1 µg Pb/sample (analyzed by GFAA), the other at 130.1 µg/sample (analyzed by ICP). These two high values were identified to be outliers using the Dixon's Outlier Test. None of the levels found in the MMBs were below the GFAA instrument detection limit. Statistics for the resulting lead levels are summarized in Table 5-3.

Table 5-3. Matrix Method Blank Sample Results by Matrix

Matrix	No. of samples	Amount (µg) of lead per sample			
		Minimum	Maximum	Mean	Standard deviation
Core	9	0.88	7.41	3.52	2.34
Sponge	5[a]	2.2[b]	7.39[c]	4.02[c]	1.90[c]
Wipe	5	0.34	2.47	1.26	0.99

[a] Two outliers of 25.1 µg and 130.1 µg were deleted.
[b] Minimum value from GFAA analysis.
[c] Values taken from ICP analysis.

The MMB provides a measure of the Pb background level in the matrix. Except for two sponge batches that showed significant lead levels in the MMB, the levels found in all other batches is insignificant. The acceptance criteria for the blanks require the blank concentration to be within three times the instrument detection limit. In all cases (except for the two sponge batches in question) the MMB met the acceptance criteria.

Background levels in test samples are considered significant if the lead concentration of the test sample concentration is less than five times the MMB level (provided the MMB is greater than three times the instrument detection limit). Most of the samples prepared with the two MMBs in question had lead concentrations more than five times the MMB level. Four samples from each batch (8 samples total) could be considered as affected by the high lead levels in the MMBs. However, when analyzing the other quality control samples prepared with each batch, we consider the lead levels in the MMB to be isolated cases. The SRM, LCS, and MB in each of these two batches were within the acceptance limits of the QAPjP. If the contamination had been widespread, all other QC and test samples would have been affected. We conclude that the MMB, while significant, does not adversely affect the measurement for lead in the rest of the samples prepared in the respective batches.

Section 6
Cleaning Solution and Soil Characterization

The main objective of this study was to assess the effect of surface tension and phosphate content of the cleaning solutions on lead-cleaning efficacy. Sixteen cleaning solutions, each in two batches, were prepared to clean coupons previously soiled with leaded soil. The first step in assessing the effect on cleaning efficacy was to characterize the prepared cleaning solutions for phosphate content, surface tension, and the amount of lead deposited onto the coupons.

6.1 Cleaning Solution Characterization

Based on the study design, 16 unique cleaning solutions were prepared using the selected cleaning agent at four concentrations to approximate the four surface tension levels of 30, 40, 60, and 70 dyne/cm. Anhydrous trisodium phosphate was added to these cleaning solutions in amounts corresponding to the four levels of 0, 3, 11, and 14 g P/gal of mixture. Two batches of each cleaning solution were prepared during the course of the coupon soiling, resulting in 32 cleaning solutions. The surface tension of each mixture was measured twice and their phosphate content was calculated. The measured characteristics are shown in Table 6-1.

As shown in Table 6-1, the discrepancies between nominal and calculated phosphate content, expressed as g P/gal, are negligible. However, the differences between nominal and corrected measured surface tension levels are considerable. Figure 6-1 displays the differences (nominal minus measured) in the form of a boxplot. In all but one case, the measured level is below the nominal level. The differences are consistently the largest at the 60 dyne/cm level. Although, on the average, the differences are smaller at the 70 dyne/cm level (synthetic hard water without cleaning agent), the measurements at that level present the greatest variability. The surface tension values for the cleaning solutions without cleaning agent range from a low of 48.9 dyne/cm to a high of 71.2 dyne/cm, with an average of 60.8 dyne/cm and a standard deviation of 8.98 dyne/cm. In addition, the variations between soil batches are large, as shown by the pairs of measurements at each nominal surface tension level.

These measured surface tension levels of the cleaning solutions were compared to those of the deionized water used to prepare the cleaning solutions. Twenty surface tension measurements were taken over a 3-month period; 19 of the measurements ranged from 66.6 dyne/cm to 71.0 dyne/cm (mean of 69.7 dyne/cm; standard deviation of 1.0 dyne/cm), with one outlying low value at 57.8 dyne/cm. Thus, the large variability in surface tension of the cleaning solutions containing no cleaning agent remains unexplained.

Table 6-1. Phosphate Content and Surface Tension Statistics

Soil batch	Phosphate content (g P/gal) Nominal level	Phosphate content (g P/gal) Calculated	Weight of cleaning agent (g/gal)	Surface tension (dyne/cm) Nominal level	Surface tension (dyne/cm) Corrected average[a]	Cleaning solution no.
1	0	0	6.29200	30	24.5	16
2	0	0	6.34000	30	24.9	25
1	0	0	0.04869	40	34.5	9
2	0	0	0.04898	40	38.1	21
1	0	0	0.00840	60	47.5	8
2	0	0	0.00847	60	50.4	27
1	0	0	0	70	66.8	3
2	0	0	0	70	71.2	17
1	3	2.99	6.33400	30	28.3	2
2	3	2.99	6.30200	30	28.8	28
1	3	2.99	0.04927	40	33.8	5
2	3	2.99	0.04978	40	37.8	23
1	3	2.99	0.00846	60	57.0	1
2	3	2.99	0.00829	60	48.0	29
1	3	2.99	0	70	67.8	10
2	3	2.99	0	70	53.3	30
1	11	11.00	6.36000	30	27.8	7
2	11	11.00	6.31000	30	27.9	32
1	11	11.00	0.04960	40	35.2	12
2	11	11.00	0.04935	40	36.4	18
1	11	11.00	0.00844	60	45.8	14
2	11	11.00	0.00833	60	44.7	31
1	11	11.00	0	70	68.1	13
2	11	11.00	0	70	49.9	26
1	14	14.00	6.33800	30	28.1	11
2	14	14.00	6.27400	30	25.6	24
1	14	14.00	0.04882	40	32.8	4
2	14	14.00	0.04894	40	31.6	19
1	14	14.00	0.00840	60	43.7	15
2	14	14.00	0.00836	60	47.7	22
1	14	14.00	0	70	60.1	6
2	14	14.00	0	70	48.9	20

[a] Average of duplicate surface tension measurements. The measured surface tension is corrected according to the ASTM test method for measuring surface tension.

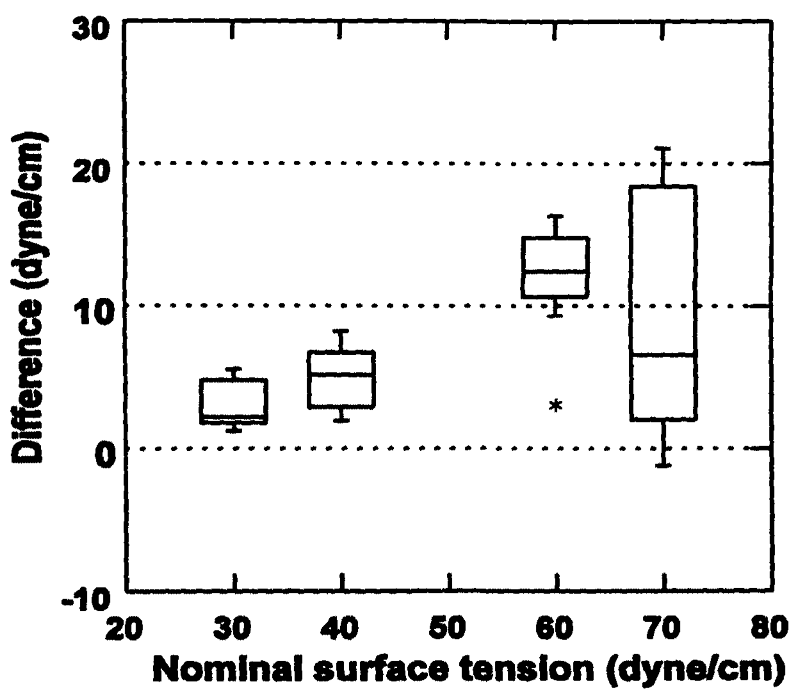


Figure 6-1. Differences Between Nominal and Measured Surface Tension Levels

The nominal surface tension levels were achieved by mixing a predetermined amount of the cleaning agent (see column 4 in Table 6-1) into synthetic hard water to which phosphate was added as indicated above. (The nominal level of 6.36 g/gal was the level recommended by the cleaning agent manufacturer. The other two non-zero nominal levels of 0.008 and 0.050 g/gal were determined in a range finding experiment prior to the cleaning tests.) The relationship between cleaning agent concentration and surface tension, across all phosphate levels, is shown in Figure 6-2. The concentrations are shown on a log scale. Note that the zero concentration results are artificially shown at the 0.0001 level (log scale) for comparison. As seen in Table 6-1, increasing the surface tension from approximately 30 dyne/cm to 40 dyne/cm required a decrease in cleaning agent concentration from approximately 6.36 g/gal to 0.050 g/gal, requiring many dilutions of the cleaner.

The average of the two surface tension measurements for each of the 32 cleaning solutions was analyzed in a two-way analysis of variance. The nominal surface tension and phosphate content and their interaction were included in the model. Neither phosphate content ($p = 0.24$) nor the interaction between surface tension and phosphate content ($p = 0.59$) were statistically significant. As expected, the nominal surface tension was highly significant ($p < 0.0001$). The least square mean differences between nominal and measured surface tensions (each with a standard error of 1.81 dyne/cm) were as follows:

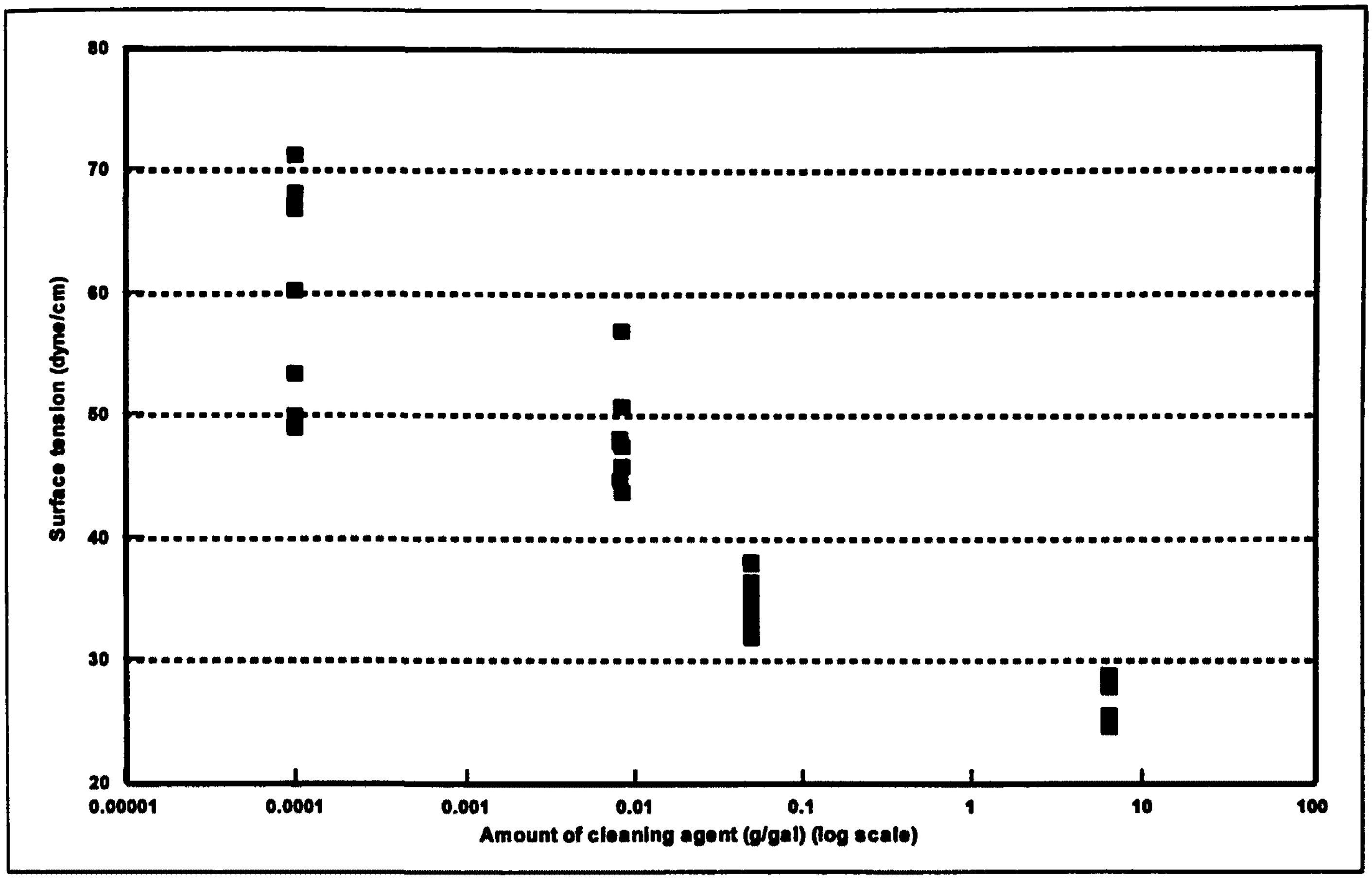
- At 30 dyne/cm: 3.03 dyne/cm
- At 40 dyne/cm: 4.96 dyne/cm
- At 60 dyne/cm: 11.9 dyne/cm
- At 70 dyne/cm: 9.28 dyne/cm

Based on these results, a decision was made to use the measured surface tension rather than the nominal surface tension levels in all subsequent statistical analyses. This means that surface tension will be treated as a covariate rather than a categorical variable in the analysis of variance modes.

6.2 Leaded Soil Characterization

A number of precleaning samples were generated in the laboratory and then analyzed by ICP and GFAA, if necessary, to assess the amount of lead deposited onto the coupons by means of an applicator rod, the amount of lead cleaned off by the wipes, and that remaining on the coupons, without any cleaning process. A total of 40 soil, rod-rinse, wipe, and core samples were analyzed.

SOIL SAMPLES: The dry and oily soil mixtures used in this study were prepared in two separate batches during the soiling process of the coupons. From each of these four batches, two samples, one of 2 mL and one of 4 mL, were taken and analyzed for lead



Note: The actual 0 g/gal level of cleaning agent is represented on this graph as 0.0001 for plotting purposes only

Figure 6-2. Relationship Between Cleaning Solution Concentration (Log Scale) and Surface Tension

content. The two amounts of 2 mL and 4 mL correspond to the amount of soil applied to plywood painted with enamel and plywood painted with latex, respectively. Thus, a total of eight soil samples were analyzed for lead content. None of these samples was analyzed by GFAA.

ROD-RINSE SAMPLES: Each soil sample was applied onto a coupon using a wire-wound rod. After each application, the rod was rinsed and the rinsate analyzed for lead. Thus, a total of eight rod-rinse samples were analyzed. Of these eight samples analyzed by ICP, two were reanalyzed by GFAA.

WIPE SAMPLES: Each soiled coupon was wiped with two wipes, and each wipe was analyzed separately. Thus, a total of 16 wipes were analyzed by ICP. The eight first wipes were analyzed by ICP only, while three of the eight second wipes were reanalyzed by GFAA.

CORE SAMPLES: Each coupon was cored as shown in Figure 4-1. The nine core samples from each coupon were composited and analyzed by ICP for lead content, resulting in a total of eight core samples. Due to their low load levels, all eight core samples were reanalyzed by GFAA. The amount of lead found in the core samples was adjusted to reflect the ratio of core surface to coupon surface as explained in Section 4.1. The adjusted result is an estimate of the amount of lead found on the entire coupon.

The precleaning lead results are summarized in Table 6-2. None of the lead amounts was below detection limit. For each of the 8 combinations of volume of soil mixture (2 mL, 4 mL), soil type (dry, oily), and soil batch (1, 2), the fourth column in the table shows the total Pb amounts per sample measured in each of the 5 samples: soil, rod rinse, first wipe, second wipe, and coupon (core adjusted for total coupon surface). The next column shows these results in total Pb per unit of soil mixture (μg Pb/mL). These results are also shown in Figure 6-3 in the form of a boxplot. The last two columns of Table 6-2 show calculations toward Pb mass balance closure without use of a cleaner; that is, under ideal sampling and analysis conditions, the quantities of lead could be apportioned as follows:

Pb in Soil - Pb in Rod rinse = Pb in Wipe #1 + Pb in Wipe #2 + Pb remaining on coupon

For each combination of soil type and soil batch, the two quantities displayed in Column 6 are those for both sides of this equation. The last column in Table 6-2 shows the quantity of lead captured as a percentage of the lead applied onto each coupon.

As shown in Table 6-2, the amount of Pb captured as a percent of the amount of Pb applied onto the coupon exceeds 100 percent for both dry and oily soils. An explanation of this result could lie in the fact that the amount of Pb remaining on a coupon was extrapolated based on the nine core samples taken from each coupon. These nine core samples represent on the average only 1.87 in^2 or approximately 1.3 percent of the total coupon surface of 144 in^2. It should be noted, however, that these figures are based on a small sample size (four dry soil tests and four oily soil tests). A more detailed lead mass balance analysis is presented in Section 7.6.

Table 6-2. Precleaning Sample Lead Results

Soil type	Soil batch	Sample type	Pb amount (µg)	Pb amount (µg/mL)	Subtotal (µg/mL)	Fraction[a] (%)
2 mL of soil mixture						
Dry	1	Soil	974.70	487.35		
		Rod rinse	33.68	16.84	470.51[b]	
		Wipe No. 1	759.86	379.93		
		Wipe No. 2	21.12	10.56		
		Coupon	319.73	159.86[c]	550.35[d]	117
	2	Soil	964.72	482.36		
		Rod rinse	26.26	13.13	469.23	
		Wipe No. 1	831.31	415.66		
		Wipe No. 2	93.74	46.87		
		Coupon	209.06	104.53	567.05	121
Oily	1	Soil	783.50	391.75		
		Rod rinse	19.65	9.83	381.93	
		Wipe No. 1	641.24	320.62		
		Wipe No. 2	14.43	7.22		
		Coupon	274.39	137.20	465.03	122
	2	Soil	909.29	454.65		
		Rod rinse	19.03	9.52	445.13	
		Wipe No. 1	764.21	382.11		
		Wipe No. 2	34.47	17.24		
		Coupon	260.55	130.27	529.61	119
4 mL of soil mixture						
Dry	1	Soil	1,931.40	482.85		
		Rod rinse	61.33	15.33	467.52	
		Wipe No. 1	1,399.90	349.98		
		Wipe No. 2	63.50	15.88		
		Coupon	496.51	124.13	489.98	105
	2	Soil	2,004.60	501.15		
		Rod rinse	42.34	10.59	490.57	
		Wipe No. 1	1,480.10	370.03		
		Wipe No. 2	136.65	34.16		
		Coupon	379.68	94.92	499.11	102
Oily	1	Soil	1,550.10	387.53		
		Rod rinse	52.83	13.21	374.32	
		Wipe No. 1	1,119.60	279.90		
		Wipe No. 2	124.99	31.25		
		Coupon	442.70	110.67	421.82	113
	2	Soil	1,987.00	496.75		
		Rod rinse	70.21	17.55	479.20	
		Wipe No. 1	1,549.10	387.28		
		Wipe No. 2	126.30	31.58		
		Coupon	416.57	104.14	522.99	109

[a] Ratio of amount (d) over amount (b), in 100 percent.
[b] Amount = Soil amount minus rod-rinse amount.
[c] Core amount was adjusted for total surface of coupon.
[d] Amount = Wipe No. 1 + Wipe No. 2 + Core amounts.

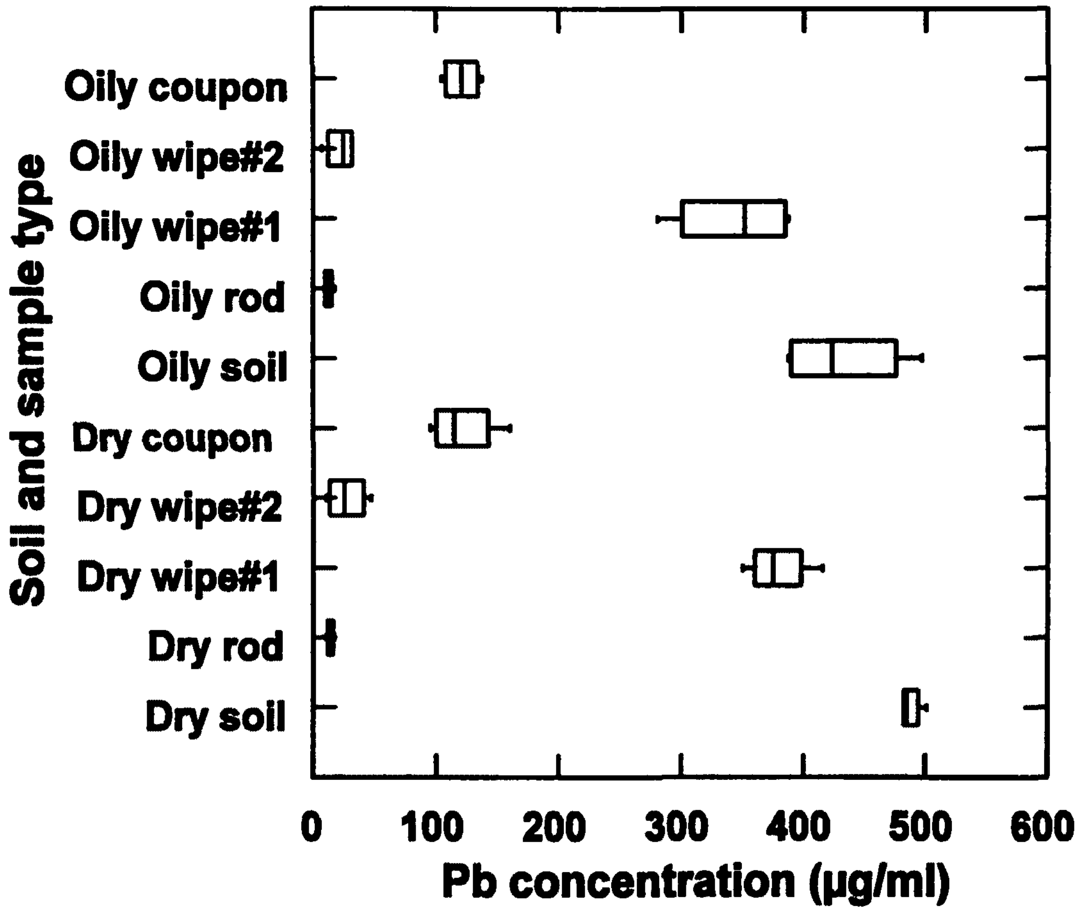


Figure 6-3. Distribution of Precleaning Lead Concentrations by Soil and Sample Types

ANALYSIS OF SOIL LEAD CONCENTRATIONS: The two types of soil (dry and oily) were each prepared in two batches over the course of the laboratory study. The lead concentrations (μg of Pb on the coupon per milliliter of soil mixture used) obtained from the eight sets of precleaning samples were analyzed to estimate the average quantity of lead applied to the coupons and whether that quantity is affected by soil type and soil batch.

Similarly to the previous study,[1] the amount of Pb in the soil, adjusted for the volume of the soil mixture and then log-transformed, was analyzed by analysis of variance (ANOVA). The two factors, soil batch and soil type, and their interaction, were included in the model. Both factors and their interaction were significant at the 5 percent significance level: soil batch ($p = 0.0122$), soil type ($p = 0.0066$), and interaction ($p = 0.0191$), based on a total of 8 samples. The least-square geometric mean concentrations and their 95 percent confidence intervals are as follows:

Dry soil: 488.4 (465.5 to 512.3) μg Pb/mL of soil mixture
Oily soil: 430.3 (410.2 to 451.4) μg Pb/mL of soil mixture

The result was an average ratio of the lead concentration in the dry to oily soil mixture of 1.13. These lead levels are slightly different from those found in the previous study (dry soil at 464.0 μg/mL; oily soil at 440.2 μg/mL), and their ratio exceeds the ratio of 1.04 determined from the recipes for the two soil mixtures. The larger confidence intervals as compared to those from the previous study are mainly due to the smaller sample size (8 versus 48).

ANALYSIS OF ROD RINSE LEAD CONCENTRATIONS: The amount of lead that remained on the applicator rod after applying the soil mixture to the coupons was analyzed in a similar fashion to that of soil samples. The effect of soil batch and soil type on the log-transformed lead concentration in the eight rod-rinse samples was estimated by ANOVA. Neither factor—soil batch ($p = 0.64$), soil type ($p = 0.52$)—nor their interaction ($p = 0.29$) had a significant effect on the log-transformed lead concentration. The least-square geometric mean concentrations and their 95 percent confidence intervals are as follows:

Dry soil: 13.8 (9.7 to 19.6) μg Pb/mL of soil mixture
Oily soil: 12.1 (8.5 to 17.3) μg Pb/mL of soil mixture

These levels represent approximately 2.8 percent of the amount of lead in the soil (either dry or oily).

ANALYSIS OF SOIL MINUS ROD-RINSE LEAD CONCENTRATIONS: The difference between the amount of lead in each soil sample and that in the corresponding rod-rinse sample was used to estimate the amount of lead applied to the coupons. Again, the log-transformed differences, adjusted for the volume of each soil mixture, were analyzed by ANOVA using the same two factors and their interaction as above. Both factors and their interaction were significant at the 5 percent significance level: soil batch ($p = 0.0074$), soil type ($p = 0.0046$), and interaction ($p = 0.0161$), based on a total of 8 samples. The least-

square geometric mean concentrations and their 95 percent confidence intervals are as follows:

> Dry soil in soil batch No. 1: 469.0 (441.0 to 498.8) μg Pb/mL of soil mixture
> Dry soil in soil batch No. 2: 479.8 (451.1 to 510.2) μg Pb/mL of soil mixture
>
> Oily soil in soil batch No. 1: 378.1 (355.5 to 402.1) μg Pb/mL of soil mixture
> Oily soil in soil batch No. 2: 461.9 (434.3 to 491.2) μg Pb/mL of soil mixture

Due to the highly significant interaction between soil type and soil batch (see the large difference between oily batch Nos. 1 and 2 soils), all lead amounts quantified in the sponge, wipe, and core samples were adjusted for the above soil lead levels separately for each soil type and soil batch when estimating cleaning efficacy (Section 7).

Section 7
Statistical Results

This section presents the statistical analysis results as they relate to the study objectives: (1) determine the lead-removal efficacy of a cleaning solution as a function of its surface tension and phosphate content; (2) quantify the amount of lead actually removed from the coupon surface by the sponge-cleaning procedure; and (3) quantify the amount of lead remaining on the surface of the test coupon. In accordance with the study design, lead data were obtained from cleaning tests performed on 128 coupons. All coupons were cleaned using a sponge and a cleaning solution. Half of the coupons were then wiped with a baby wipe; the other half were not wiped; all coupons were cored. The statistical analysis results of the amount of lead in each of the four sample types—sponge, wipe, coupon with wiping, coupon without wiping—are presented separately in the following sections. The effect of surface tension and phosphate content of the cleaning solution on the results is discussed in each section.

7.1 Treatment of Surface Tension in the Statistical Analyses

According to the full factorial experimental design presented in Section 3.1, all combinations of phosphate content (0, 3, 11, and 14 g P/gal), surface tension (30, 40, 60, and 70 dyne/cm), soil type (dry and oily), soil batch (1 and 2), and substrate (enamel- and latex-painted plywood) were tested twice. This replication was, in effect, a pseudo-replication, since the testing required that the 16 cleaning solutions (4 phosphate levels x 4 surface tension levels) be prepared in two batches, resulting in 16 pairs of cleaning solutions. The two theoretically identical cleaning solutions in each pair, however, were each characterized as to their surface tension and phosphate content. As was shown in Table 6-1, the discrepancies between pairs of surface tension measurements are considerable at the higher nominal surface tension levels (60 and 70 dyne/cm), while the discrepancies between measured and nominal phosphate levels are negligible. Therefore, it was decided that the characterization of the cleaning solution in its ability to wet a surface would be more reliably characterized in this study by using the measured surface tension of each cleaning solution. Thus, in all subsequent statistical analyses, the measured surface tension, rather than the four nominal levels, was used as a predictor variable for lead-cleaning efficacy of the cleaners. Surface tension was treated as a continuous independent variable, or covariate, in the statistical analysis.

7.2 Percentage Amount of Lead Removed by Sponge

For each cleaner test, the amount of lead applied to the coupon was predicted by the amount of lead in the soil minus the amount of lead in the rod rinse (Section 6.2). The estimates of lead quantities applied, separately for each batch of dry and oily soil, were

469.0 µg/mL for dry soil from batch 1; 479.8 µg/mL for dry soil from batch 2; 378.1 µg/mL for oily soil from batch 1; and 461.9 µg/mL for oily soil from batch 2. The dependent (response) variable used in the analysis was the amount of lead removed by the sponge expressed as a percentage of the quantity of lead applied on the coupon. The quantities of lead applied, expressed in µg/mL of soil mixture, were adjusted for the amount of soil mixture applied, that is, 2 mL on enamel-painted coupons, and 4 mL on latex-painted coupons. The dependent variable was further log-transformed for statistical analysis; thus, the quantity, ln[(amount Pb removed by sponge/amount Pb applied) x 100] is the variable analyzed.

An analysis of covariance of the log-transformed percentage of lead removed by the sponge was performed. The main effects (phosphate content, soil type, and substrate) and all their two- and three-way interactions were included in the model. Soil batch was included as a blocking factor. Surface tension was treated as a continuous variable, or covariate, and was crossed with all other terms included in the model. Thus, a total of 13 terms were included in the model.

A significance level of 5 percent was selected throughout. The data were inspected for statistical outliers, based on the extreme studentized residuals. A total of six outliers were sequentially excluded from analysis (e.g., one at a time, and the model rerun each time). Additionally, based on the significance level (p-value) of the F-statistic calculated for all terms in the model, terms in the model were sequentially removed from analysis if the F-value was below 1.5. This is based on the assumption that although a factor or interaction might not be statistically significant (i.e., $p < 0.05$), the inclusion of that factor if its F-value is above 1.5 will provide a more sensitive test for the remaining statistically significant terms in the analysis of variance. The final results from this analysis of covariance are summarized in Table 7-1. All main effects and interactions with an F-value of 1.5 or more are included in the model. Only those main effects and interactions with a p-value of 0.05 or more are considered to be statistically significant.

Overall, the geometric mean percent amount of lead removed by the sponge is estimated at 72.7 percent, with a 95 percent confidence interval of 71.5 to 73.9 percent. Of the main effects and interactions included in Table 7-1 (all with F-values above 1.5), only three are statistically significant at the 5 percent level: the three-way surface tension by substrate by soil type interaction ($p = 0.0006$); the covariate, surface tension ($p = 0.0015$); and the two-way surface tension by phosphate content interaction ($p = 0.0210$). Note that phosphate content is not a significant factor in this model.

Table 7-1. Analysis of Covariance Results: Cleaning Efficacy of Sponges

Dependent (response) variable	Log-transformed percentage of lead removed using sponge to clean coupons				
Number of observations	122 (6 statistical outliers removed)				
Root mean square error	0.0907 (corresponding to a coefficient of variation in the untransformed unit of 9.5 percent)				
Mean response	4.2859 (corresponding to a geometric mean in the untransformed unit of 72.7 percent)				
Factor	Degrees of freedom	Sum of squares	Mean square	F ratio	Prob>F
Surface tension	1	0.0871	0.0871	10.59	0.0015
Phosphate	3	0.0410	0.0137	1.66	0.1801
Substrate	1	0.0201	0.0201	2.44	0.1210
Soil type	1	0.0153	0.0153	1.86	0.1751
Surface tension * phosphate	3	0.0835	0.0278	3.38	0.0210
Phosphate * substrate	3	0.0557	0.0186	2.25	0.0863
Surface tension * substrate * soil type	3	0.1537	0.0512	6.23	0.0006
Whole-model analysis of variance test					
Source	Degrees of freedom	Sum of squares	Mean square	F-ratio	Prob>F
Model	15	0.7448	0.0497	6.03	0.0001
Error	106	0.8722	0.0082		
Corrected total	121	1.6170			

In this overall covariance model, surface tension has a statistically significant slope of -0.0036 ln(percentage amount of lead removed) per dyne/cm [with a standard error of 0.0017 ln(%) per dyne/cm]. The negative overall slope would indicate that the percentage of lead removed by the sponge decreases with increasing surface tension, or conversely, that lower surface tension cleaning solutions are associated with better sponge cleaning. However, the significant three-way interaction between surface tension (covariate) and the two-way interaction of substrate by soil type indicates that the regression lines of percentage lead removed by the sponge versus surface tension in the four cells defined by substrate type (enamel and latex) and soil type (dry and oily) are not parallel. The analysis of covariance was therefore followed up by four separate analyses of covariance, one for each of the four combinations of substrate and soil type. Phosphate content was included as a main effect, along with surface tension (the covariate), and their interaction. The interaction term, surface tension by phosphate content, was not significant in any of the four models. Thus, the four analysis of covariance models were rerun without that term, including the covariate and the main effect only. The data were checked for statistical outliers and two additional outliers were removed.

Following sequential removal of non-significant effects (F-value below 1.5), only one model was significant: phosphate content was statistically significant ($p = 0.0005$) for the

latex and dry soil combination. Surface tension was not significant in any of the models. Table 7-2 summarizes the percentage of lead removed by the sponge as a function of phosphate content when cleaning latex-painted coupons soiled with dry soil. These statistics include the least-square geometric mean percent amount of lead removed by the sponge and its 95 confidence limits. These statistics are also displayed in Figure 7-1 and show an inconsistent trend across the four levels of phosphate content. The largest percentage of lead (78 percent) is removed when the phosphate content of the cleaning solution is 3 g P/gal, then decreases with increasing phosphate content; the lowest cleaning efficacy (67 percent) is obtained when the cleaning solution contains no phosphate.

Table 7-2. Mean Cleaning Efficacy of Sponges by Phosphate Content When Used on Latex-Painted Coupons Soiled with Dry Soil

Phosphate content (g P/gal)	Percentage of Pb removed by sponge (%)		
		95% Confidence limits	
	Mean	Lower	Upper
0	67	63	70
3	78	74	83
11	70	66	74
14	69	65	73

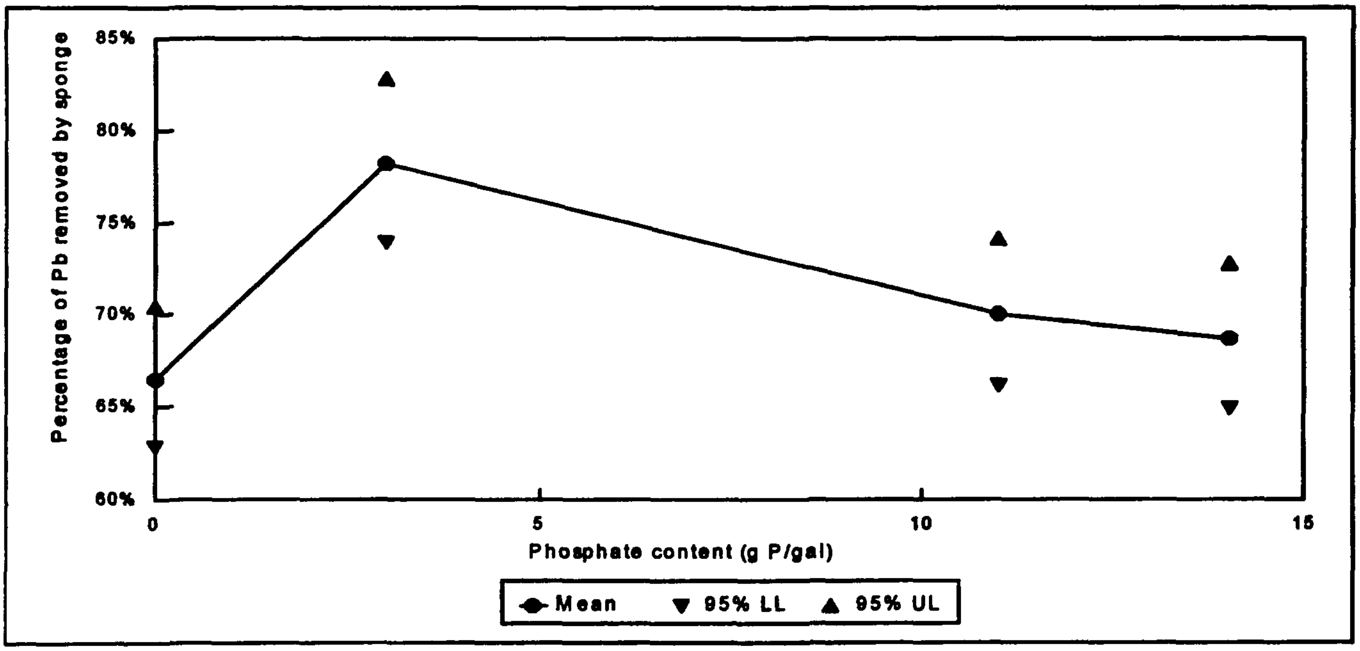


Figure 7-1. Mean Cleaning Efficacy of Sponges versus Phosphate Content When Used on Latex-Painted Coupons Soiled with Dry Soil

The percent of lead removed by the sponge could not be predicted by the surface tension of the cleaning solution for the four combinations of substrate and soil type. Nevertheless, for illustrative purposes, Figure 7-2 shows a scatterplot of the percentage amount of lead removed by the sponge as a function of surface tension, separately for each combination of substrate and soil type. In each case, a regression line on the log-scale is shown, although not significant. Regression statistics are summarized in Table 7-3, showing the slope (on the log-scale) and intercept of each regression, noting that neither regression is significant.

Table 7-3. Regression Statistics of Percent Lead Removed by Sponge versus Surface Tension (Nonsignificant Results)

Substrate type	Soil type	No. of measurements	Intercept[a] (%)	Slope of surface tension[b]	Significance level (p-value)
Enamel	Dry	29	77	-0.0013	0.29
	Oily	31	84	-0.0013	0.25
Latex	Dry	32	72	-0.0004	0.72
	Oily	28	71	-0.0007	0.59

[a] Intercept in untransformed scale.
[b] Slope on log-scale.

In summary, except for the single case of latex-painted coupons soiled with dry soil in which phosphate content was statistically significant, none of the factors considered in the models—surface tension and phosphate content—had a significant effect on the amount of lead removed by the sponge, expressed as a percent of lead applied.

7.3 Percentage Amount of Lead Removed by Wipe

Of the 128 coupons soiled and cleaned using the sponge and the cleaning solution, half were wiped with a baby wipe. The design used was a balanced full factorial design with respect to phosphate content, nominal surface tension, substrate, and soil type. However, soil batch was confounded with the cleaning solutions as per design (Appendix A) and was not included in the analysis. The statistical approach for analysis of the cleaning efficacy of the wipes was similar to that above, with the omission of soil batch. The log-transformed percentage amount of lead removed by the wipe was analyzed in an analysis of covariance, including all factors, their two-way interactions, and selected three-way interactions. Terms in the models for which the F-value was below 1.5 were excluded from the model in a sequential fashion. The final analysis of covariance model results are shown in Table 7-4.

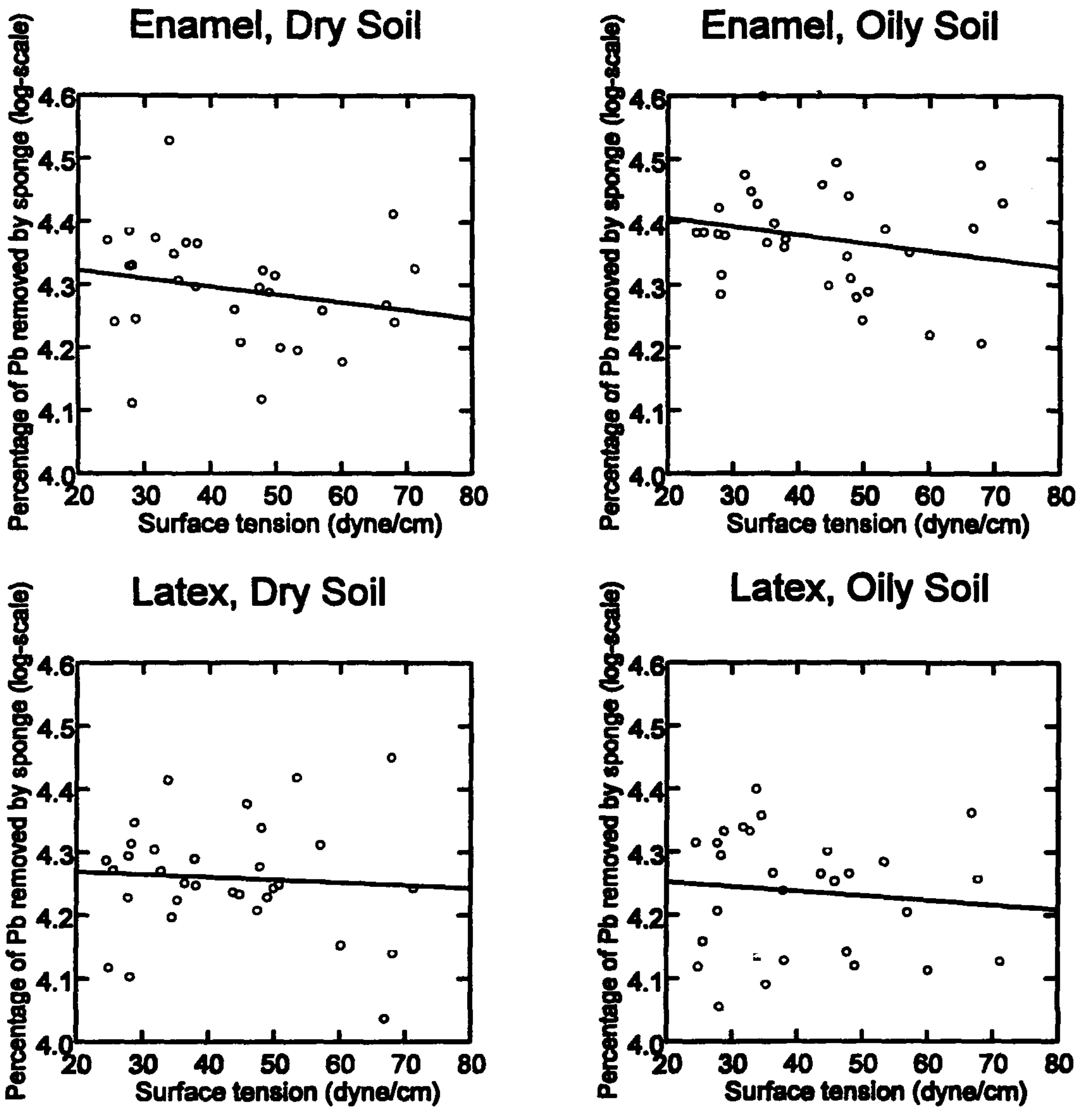


Figure 7-2. Percent Lead Removed by Sponge Versus Surface Tension, Separately by Substrate and Soil Types

Table 7-4. Analysis of Covariance Results: Cleaning Efficacy of Wipes

Dependent (response) variable	Log-transformed percentage of lead removed using baby wipes to clean coupons				
Number of observations	64				
Root mean square error	0.4253 (corresponding to a coefficient of variation in the untransformed unit of 53 percent)				
Mean response	0.3879 (corresponding to a geometric mean in the untransformed unit of 1.47 percent)				
Factor	Degrees of freedom	Sum of squares	Mean square	F ratio	Prob>F
Phosphate	3	4.70	1.57	8.66	0.0001
Substrate	1	9.68	9.68	53.51	0.0001
Soil type	1	7.14	7.14	39.47	0.0001
Surface tension	1	2.00	2.00	11.04	0.0017
Phosphate * substrate	3	3.19	1.06	5.87	0.0017
Phosphate * substrate * soil type	7	2.60	0.37	2.05	0.0676
Whole-model analysis of variance test					
Source	Degrees of freedom	Sum of squares	Mean square	F-ratio	Prob>F
Model	16	30.39	1.90	10.50	0.0001
Error	47	8.50	0.18		
Corrected total	63	38.89			

The geometric mean percentage amount of lead removed by wipes is estimated at 1.47 percent, with a 95 percent confidence interval of 1.32 to 1.64 percent. As seen in Table 7-4, substrate and soil type account for a large proportion of the variance in the data explained by the model. Except for the marginally significant three-way interaction (phosphate content by substrate by soil type, with a p-value of 0.0676), all the effects shown in Table 7-4 are highly significant.

Surface tension has an overall significant slope of 0.0141 ln(percentage amount of lead removed) per dyne/cm [with a standard error of 0.0042 ln(%) per dyne/cm]. The positive slope indicates that the percentage of lead removed by the wipe increases with increasing surface tension, possibly indicating that a larger percentage of lead amount remained on the coupon surface following sponge cleaning when using a cleaning solution with higher surface tension. This finding is in agreement with that found earlier where, overall, the sponge cleaning efficacy increased with decreasing surface tension of the cleaning solution (Section 7.2). It should be noted that, although highly significant (p-value < 0.0001), the slope of 0.0141 ln(%) per dyne/cm is small, especially when considering the available range of surface tension of 30 to 70 dyne/cm.

Separately for each level of phosphate content, substrate type, and soil type, Table 7-5 shows the geometric mean (and 95 percent confidence limits) percentage of lead removed

by the wipe. The results for phosphate content are also presented in Figure 7-3, showing a lack of consistent pattern across the levels of phosphate content. The results in Table 7-5 also show that a higher percentage of lead amount is removed by the wipe from latex-painted surfaces than from enamel-painted surfaces, and when using oily soil rather than dry soil. This finding would suggest that latex-painted surfaces (rougher than enamel-painted surfaces) and oily soils are more difficult to clean. In summary, the mean percentages of amount of lead removed by the wipe were overall in the range of 1.00 percent to 2.24 percent, so all were relatively small and of little practical importance.

Table 7-5. Mean Cleaning Efficacy of Wipes, Separately for Phosphate Content, Substrate Type, and Soil Types

		Percentage of Pb removed by wipe (%)		
			95% Confidence limits	
Factor	Factor	Mean	Lower	Upper
Phosphate content (g P/gal)	0	2.24	1.79	2.81
	3	1.52	1.21	1.90
	11	1.05	0.84	1.32
	14	1.32	1.05	1.65
Substrate	Enamel	1.00	0.86	1.16
	Latex	2.17	1.87	2.53
Soil type	Dry	1.06	0.91	1.23
	Oily	2.06	1.77	2.40

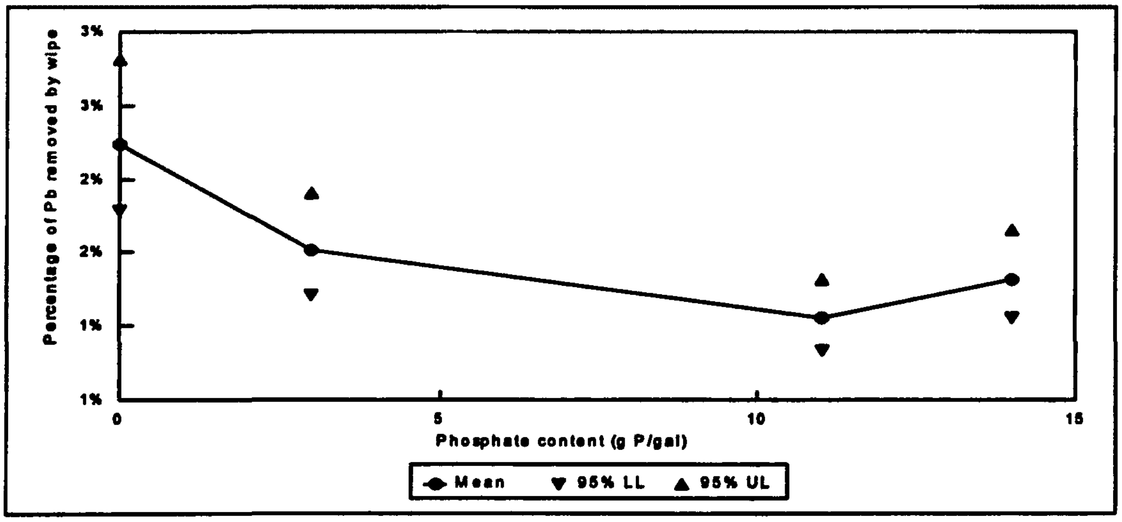


Figure 7-3. Mean Cleaning Efficacy of Wipes Versus Phosphate Content

For completeness and comparison to Section 7.2, the percentages of amount of lead removed by wipes (on log-scale) are plotted versus surface tension in Figure 7-4, separately for the four combinations of substrate and soil type.

7.4 Residual Lead Remaining on Coupon After Sponge-Cleaning and Wiping

Half the coupons were cleaned with a sponge and then a wipe. The results from these 64 coupons were used in this analysis. The same design factors as those used in the analysis of covariance of wipe results apply here. The dependent (response) variable used is as before the log-transformed percentage of lead remaining on the coupon. Again, the denominator of the fraction is the amount of lead applied to the coupon before any cleaning activity, not that remaining on the coupon after cleaning.

Table 7-6 summarizes the analysis of variance results. Of all the main effects included in the model—phosphate content, surface tension (covariate), soil type, and substrate—and their two- and three-way interactions, only the main effects for substrate and soil type remained in the model after excluding all terms with an F-value below 1.5. In summary, the geometric mean percentage amount of lead remaining on the coupons was 21.5 percent, with a 95 percent confidence interval of 19.9 to 23.3 percent. Neither surface tension nor phosphate content affected the residual lead remaining on coupons after sponge-cleaning and wiping.

Table 7-7 shows the geometric mean residual lead remaining on the coupons, separately for substrate and soil type. Based on this analysis, more lead remained on enamel-painted plywood (25 percent) than on latex-painted plywood (19 percent), which contradicts the notion that a smooth surface is more easily cleaned than a rough surface. Also, residual lead is higher on surfaces soiled with oily soil (24 percent) than on surfaces soiled with dry soil (20 percent); this seems intuitive, since oily soil adheres more easily to the surface and is thus more difficult to remove. Again, for completeness and comparison to the previous results, the percentages of amount of lead remaining on the coupons after sponge cleaning and wiping (on log-scale) are plotted versus surface tension in Figure 7-5, separately for the four combinations of substrate and soil type.

7.5 Residual Lead Remaining on Coupon After Sponge-Cleaning Only

Sixty-four coupon results from the coupons that were only sponge-cleaned were analyzed to assess the effect of the design factors on the residual lead remaining on the coupons. The same approach as in Section 7.4 was followed. The analysis of covariance model first included all main effects—phosphate content, surface tension (covariate), soil

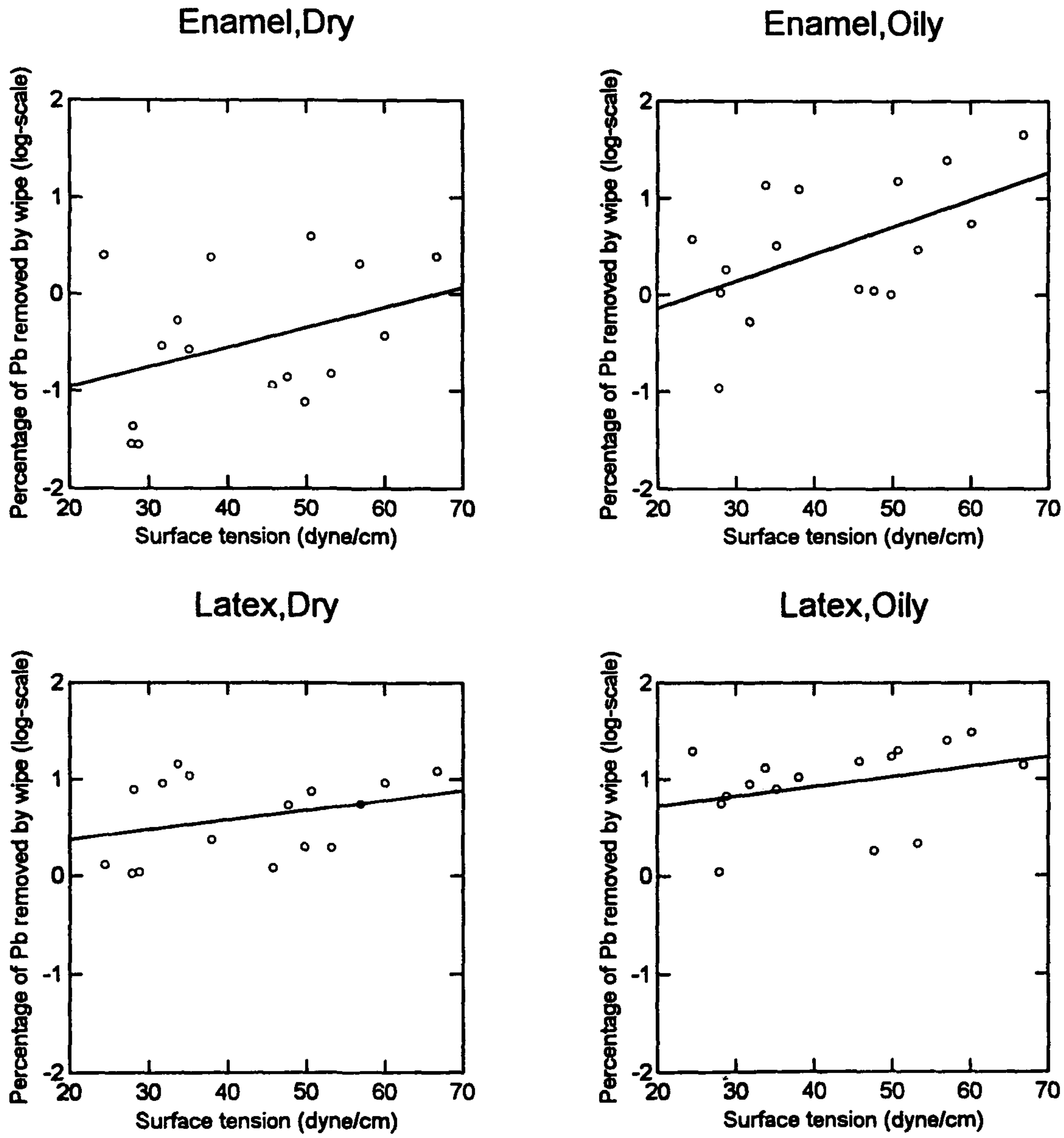


Figure 7-4. Mean Cleaning Efficacy of Wipes Versus Surface Tension, Separately by Substrate and Soil Types

Table 7-6. Analysis of Variance Results: Residual Lead on Coupons After Cleaning with Sponge and Wipe

Dependent (response) variable	Log-transformed percentage lead remaining on coupons after sponge-cleaning and wiping				
Number of observations	62 (2 statistical outliers removed)				
Root mean square error	0.3079 (corresponding to a coefficient of variation in the untransformed unit of 36 percent)				
Mean response	3.0682 (corresponding to a geometric mean in the untransformed unit of 21.5 percent)				
Factor	Degrees of freedom	Sum of squares	Mean square	F ratio	Prob>F
Substrate	1	1.08	1.08	11.37	0.0013
Soil type	1	0.47	0.47	4.98	0.0294
Whole-model analysis of variance test					
Source	Degrees of freedom	Sum of squares	Mean square	F-ratio	Prob>F
Model	2	1.55	0.78	8.18	0.0007
Error	59	5.59	0.09		
Corrected total	61	7.14			

Table 7-7. Residual Lead on Coupons After Cleaning with Sponge and Wipe by Substrate and Soil Type

		Percentage of Pb remaining on coupon (%)		
			95% Confidence limits	
Substrate	Soil type	Mean	Lower	Upper
Enamel		25	22	28
Latex		19	17	21
	Dry	20	18	22
	Oily	24	21	26

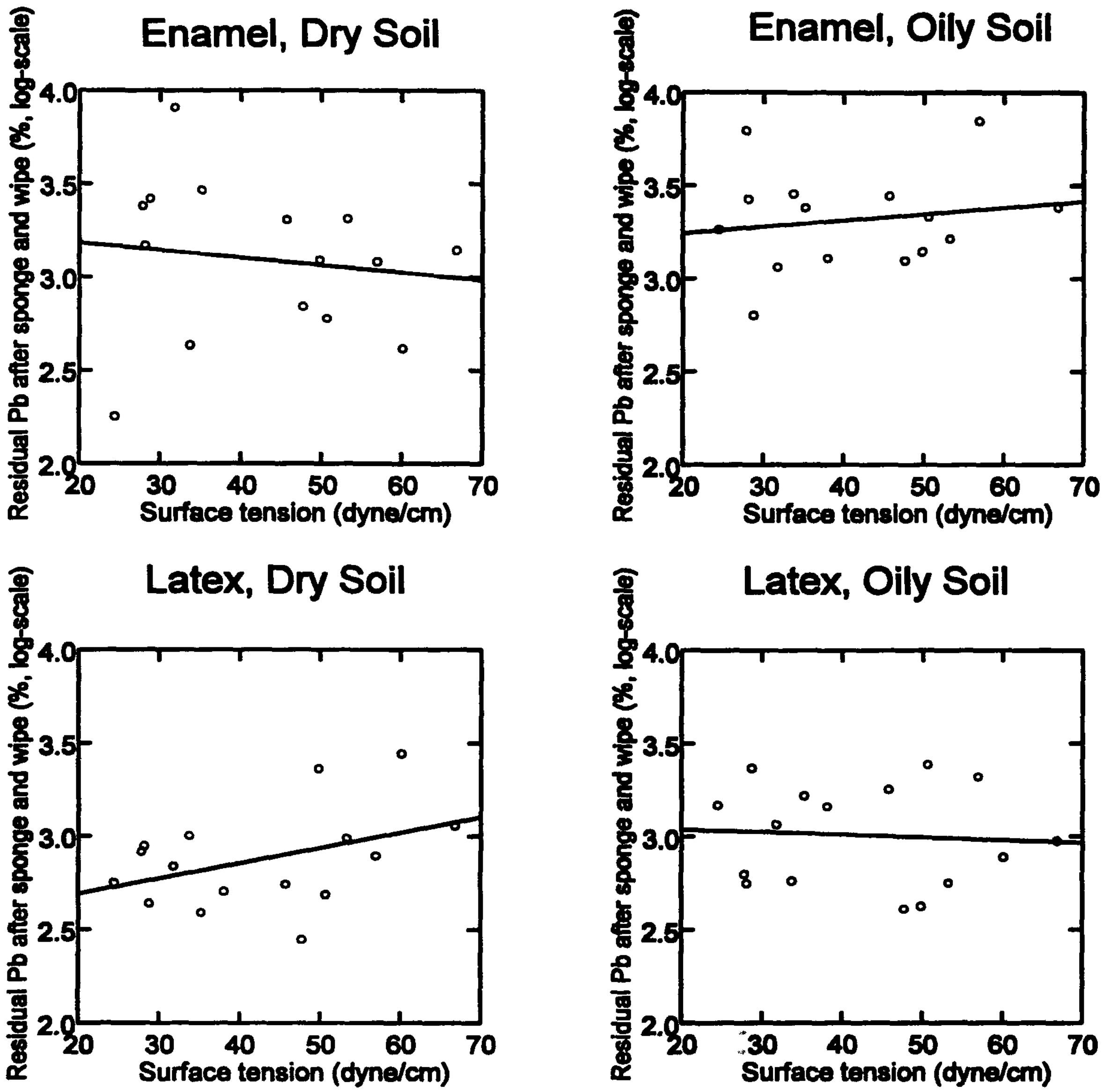


Figure 7-5. Residual Lead Remaining on Coupons After Sponge Cleaning and Wiping Versus Surface Tension, Separately by Substrate and Soil Types

type, and substrate— and their two- and three-way interactions. Those terms with F-values below 1.5 were excluded sequentially from the model. Table 7-8 summarizes the final analysis of covariance results. One main effect, substrate, and a large number of interactions remained in the model; however, most were not statistically significant at the 5 percent significance level but were retained in the model to improve the sensitivity of the F-test for the other terms in the model. Overall, the geometric mean residual lead remaining on the coupons after sponge-cleaning only was 24.2 percent, with a 95 percent confidence interval of 22.2 to 26.4 percent. This percentage is slightly above that obtained for sponged and wiped coupons (21.5 percent).

Table 7-8. Analysis of Covariance Results: Residual Lead on Coupons After Cleaning with Sponge Only

Dependent (response) variable	Log-transformed percentage lead remaining on coupons after cleaning with sponge only				
Number of observations	64				
Root mean square error	0.3408 (corresponding to a coefficient of variation in the untransformed unit of 41 percent)				
Mean response	3.1880 (corresponding to a geometric mean in the untransformed unit of 24.2 percent)				
Factor	Degrees of freedom	Sum of squares	Mean square	F ratio	Prob>F
Substrate	1	0.53	0.53	4.60	0.0378
Surface tension * phosphate content	3	0.55	0.18	1.59	0.2067
Surface tension * substrate	1	0.28	0.28	2.41	0.1280
Phosphate content * soil type	6	1.10	0.18	1.58	0.1754
Substrate * soil type	1	0.37	0.37	3.22	0.0799
Phosphate * substrate * soil type	6	1.31	0.22	1.88	0.1071
Whole-model analysis of variance test					
Source	Degrees of freedom	Sum of squares	Mean square	F-ratio	Prob>F
Model	20	7.22	0.36	3.11	0.0009
Error	43	4.99	0.12		
Corrected total	63	12.21			

As shown in Table 7-8, substrate (enamel- or latex-painted plywood) is the only significant effect in this model ($p = 0.0378$). The two interactions, substrate by soil type ($p = 0.0799$) and phosphate by substrate by soil type ($p = 0.1071$), are only marginally significant. Table 7-9 summarizes the geometric mean percentage amount of lead remaining on the coupons and its 95 percent confidence limits for the two types of substrates. As for coupons that were sponged and wiped, a large percentage amount of lead remains on enamel-painted surfaces (26 percent) than on latex-painted surfaces (22 percent). Again, this is counter-intuitive since enamel-painted surfaces are smoother and therefore would be easier to clean.

Table 7-9. Residual Lead on Coupons After Cleaning with Sponge Only by Substrate

		Percentage of Pb remaining on coupon (%)		
			95% Confidence limits	
Substrate	Soil type	Mean	Lower	Upper
Enamel		26	23	30
Latex		22	19	25

Neither phosphate content nor surface tension are significant predictors of residual lead on coupons after sponge cleaning only.

For completeness, residual amounts of lead (on log-scale) were plotted versus surface tension, separately for the four combinations of substrate and soil type. The plots are shown in Figure 7-6.

7.6 Estimation of Lead Mass Balance

In contrast to the previous study,[1] lead results in this study were available for all the components in the soiling and cleaning steps. That is, the amount of soil applied to the coupon was estimated, as was that picked up by the sponge and that by the wipe (if a wipe was used), and that remaining on the coupon. Thus, for each individual coupon, the total amount of lead accounted for can be estimated by simply adding up the various components (sponge plus wipe plus coupon or sponge plus coupon). The percentage of total lead accounted for in each cleaning test was calculated and then analyzed in the same fashion as were previous response variables. An analysis of covariance of the log-transformed total percentage lead was performed using all the factors—phosphate content, surface tension (covariate), soil type, soil batch, and substrate—and their two- and three-way interactions in the statistical model. Again, terms with an F-value below 1.5 were excluded in a sequential fashion. The analysis of covariance results are presented in Table 7-10.

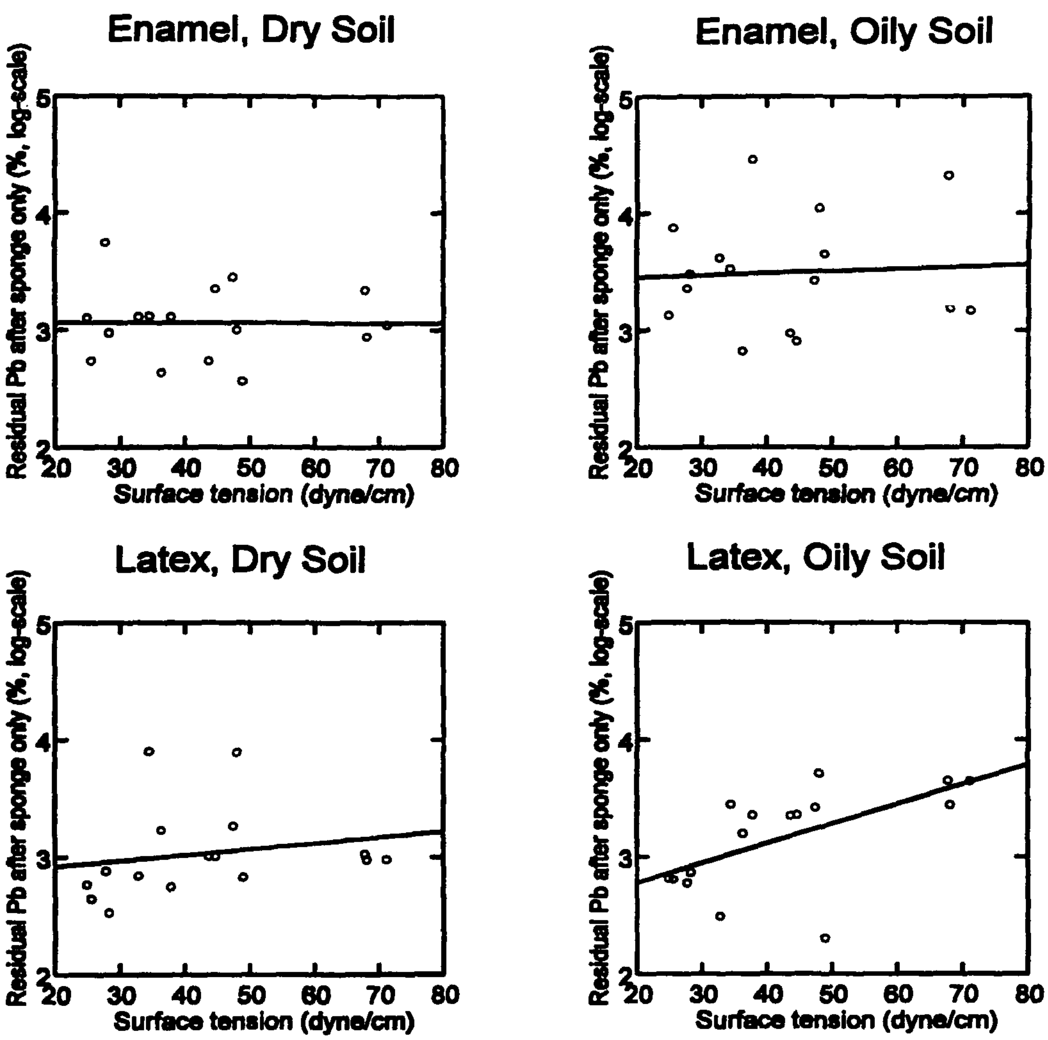


Figure 7-6. Residual Lead Remaining on Coupons After Sponge Cleaning Only Versus Surface Tension, by Substrate and Soil Types

Table 7-10. Analysis of Covariance Results: Total Lead Accounted for in the Cleaning Process

Dependent (response) variable	Log-transformed percentage of lead accounted for				
Number of observations	127 (1 statistical outlier excluded)				
Root mean square error	0.1300 (corresponding to a coefficient of variation in the untransformed unit of 13.9 percent)				
Mean response	4.5738 (corresponding to a geometric mean in the untransformed unit of 96.9 percent)				
Factor	Degrees of freedom	Sum of squares	Mean square	F ratio	Prob>F
Phosphate	3	0.15	0.05	2.98	0.0344
Substrate	1	0.04	0.04	2.62	0.1086
Soil bath	1	0.09	0.09	5.27	0.0235
Surface tension * phosphate	3	0.21	0.07	4.17	0.0076
Surface tension * substrate * soil type	3	0.52	0.17	10.16	0.0001
Whole-model analysis of variance test					
Source	Degrees of freedom	Sum of squares	Mean square	F-ratio	Prob>F
Model	12	1.68	0.14	8.29	0.0001
Error	114	1.93	0.02		
Corrected total	126	3.61			

Overall, the geometric mean percentage lead accounted for was 96.9 percent with a confidence interval of 94.7 to 99.1 to percent. Thus, between 0.85 and 5.28 percent of the lead was unaccounted for. Based on the individual percentage of lead estimated in the analyses above, a similar mean total lead percentage was accounted for:

- Sponge and wipe: 72.7 (sponge) + 1.47 (wipe) + 21.5 (coupon) = 95.6 percent
- Sponge-cleaning only: 72.7 (sponge) + 24.2 (coupon) = 96.9 percent

The slight differences among the three mass balance estimates resulted from the different factors and the different subsets of the data used in different analysis of covariance models.

From this analysis, between 0.85 and 5.28 percent of the lead applied was unaccounted for. This small discrepancy could be due to several factors. One factor could be the estimation of the amount of lead applied. The estimation of the quantity of lead applied to the coupons was based on a small set of eight experiments (Section 6.2). As per recipe, the concentration of lead would be approximately 481 μg/mL in dry soil and 463 μg/mL of oily soil. The estimates from this study are 485.1 μg/mL (batch 1) and 491.7 μg/mL (batch 2) in dry soil; and 389.6 μg/mL (batch 1) and 475.2 μg/mL (batch 2) in oily soil. Three of these estimates are above recipe levels, while the fourth is well below recipe value. Thus, overestimating the amount applied could result in underestimating the percentage accounted for. Furthermore, as shown in Figures 5-1 and 5-2, lead recovery from coupons and sponges is in most cases well below 100 percent. Both coupons and sponges are two new and difficult matrices from which lead was extracted using Modified EPA Method 3050A. It is likely that the consistently low lead recovery from coupons and sponges also contributes to the deficit in mass balance.

For completeness, mass balance results (on log-scale) were plotted versus surface tension, separately for the four combinations of substrate and soil types. These plots are shown in Figure 7-7.

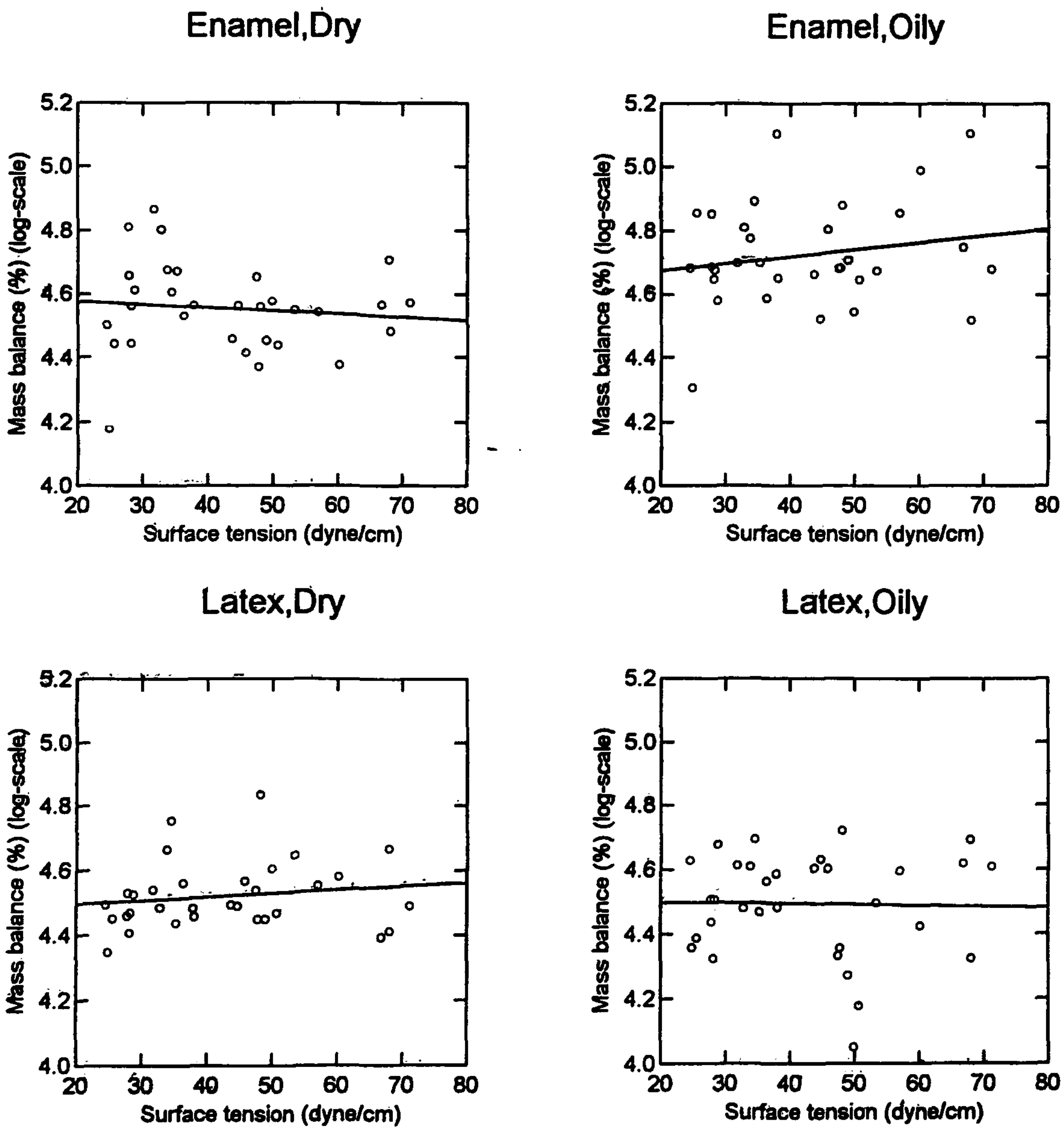


Figure 7-7. Total Percentage of Lead Accounted for Versus Surface Tension, by Substrate and Soil Types

Section 8
References

1. Rogers, J., Hartley, W., and Cooper, G. *Laboratory Study of Lead-Cleaning Efficacy.* Report No. EPA 747-R-97-002. March 1997.

2. USEPA. July 12, 1995. *Quality Assurance Project Plan for Pb-Cleaning Efficacy for Lead Abatement in Housing, Revision No. 4.* Prepared under contract by Midwest Research Institute, Kansas City, MO.

3. Addition to QAPjP for Pb-Cleaning Efficacy for Lead Abatement in Housing, Revision No. 4, July 12, 1995. Appendix B-1, *Analytical Procedure Modified Method 3050A for Analysis of Lead (Pb) in Sponge Samples.*

4. Addition to QAPjP for Pb-Cleaning Efficacy for Lead Abatement in Housing, Revision No. 4, July 12, 1995. Appendix B-2, *Analytical Procedure Modified Method 3050A for Analysis of Lead (Pb) in Core Samples.*

Appendix A

Test Schedule

Table A-1 (Continued)

Soil batch	Measurement method	Cleaning solution	Surface tension	Phosphate level	Soil type	Substrate	Test sequence number
1	Wipe	11	30	14	Oily	Enamel	44
1	Wipe	12	40	11	Dry	Enamel	45
1	Wipe	12	40	11	Oily	Latex	46
1	Wipe	12	40	11	Dry	Latex	47
1	Wipe	12	40	11	Oily	Enamel	48
1	No wipe	13	70	11	Dry	Enamel	49
1	No wipe	13	70	11	Dry	Latex	50
1	No wipe	13	70	11	Oily	Latex	51
1	No wipe	13	70	11	Oily	Enamel	52
1	Wipe	14	60	11	Oily	Enamel	53
1	Wipe	14	60	11	Oily	Latex	54
1	Wipe	14	60	11	Dry	Latex	55
1	Wipe	14	60	11	Dry	Enamel	56
1	No wipe	15	60	14	Oily	Enamel	57
1	No wipe	15	60	14	Oily	Latex	58
1	No wipe	15	60	14	Dry	Latex	59
1	No wipe	15	60	14	Dry	Enamel	60
1	Wipe	16	30	0	Dry	Latex	61
1	Wipe	16	30	0	Oily	Latex	62
1	Wipe	16	30	0	Oily	Enamel	63
1	Wipe	16	30	0	Dry	Enamel	64
2	No wipe	17	70	0	Oily	Latex	65
2	No wipe	17	70	0	Dry	Enamel	66
2	No wipe	17	70	0	Dry	Latex	67
2	No wipe	17	70	0	Oily	Enamel	68
2	No wipe	18	40	11	Dry	Latex	69
2	No wipe	18	40	11	Oily	Enamel	70
2	No wipe	18	40	11	Oily	Latex	71
2	No wipe	18	40	11	Dry	Enamel	72
2	Wipe	19	40	14	Oily	Latex	73
2	Wipe	19	40	14	Oily	Enamel	74
2	Wipe	19	40	14	Dry	Latex	75
2	Wipe	19	40	14	Dry	Enamel	76
2	No wipe	20	70	14	Oily	Enamel	77
2	No wipe	20	70	14	Dry	Latex	78
2	No wipe	20	70	14	Oily	Latex	79
2	No wipe	20	70	14	Dry	Enamel	80
2	Wipe	21	40	0	Dry	Latex	81
2	Wipe	21	40	0	Dry	Enamel	82
2	Wipe	21	40	0	Oily	Enamel	83
2	Wipe	21	40	0	Oily	Latex	84
2				Include precleaning test No. 5: dry soil batch 2 on latex			
2	Wipe	22	60	14	Dry	Enamel	85
2	Wipe	22	60	14	Dry	Latex	86
2	Wipe	22	60	14	Oily	Enamel	87
2	Wipe	22	60	14	Oily	Latex	88

Table A-1 (Continued)

Soil batch	Measurement method	Cleaning solution	Surface tension	Phosphate level	Soil type	Substrate	Test sequence number
2	Include precleaning test No. 6: dry soil batch 2 on enamel						
2	No wipe	23	40	3	Dry	Enamel	89
2	No wipe	23	40	3	Dry	Latex	90
2	No wipe	23	40	3	Oily	Latex	91
2	No wipe	23	40	3	Oily	Enamel	92
2	No wipe	24	30	14	Dry	Enamel	93
2	No wipe	24	30	14	Oily	Enamel	94
2	No wipe	24	30	14	Dry	Latex	95
2	No wipe	24	30	14	Oily	Latex	96
2	No wipe	25	30	0	Oily	Latex	97
2	No wipe	25	30	0	Dry	Latex	98
2	No wipe	25	30	0	Dry	Enamel	99
2	No wipe	25	30	0	Oily	Enamel	100
2	Wipe	26	70	11	Oily	Enamel	101
2	Wipe	26	70	11	Oily	Latex	102
2	Wipe	26	70	11	Dry	Enamel	103
2	Wipe	26	70	11	Dry	Latex	104
2	Wipe	27	60	0	Oily	Enamel	105
2	Wipe	27	60	0	Dry	Latex	106
2	Wipe	27	60	0	Dry	Enamel	107
2	Wipe	27	60	0	Oily	Latex	108
2	Include precleaning test No. 7: oily soil batch 2 on enamel						
2	Wipe	28	30	3	Dry	Enamel	109
2	Wipe	28	30	3	Oily	Latex	110
2	Wipe	28	30	3	Oily	Enamel	111
2	Wipe	28	30	3	Dry	Latex	112
2	No wipe	29	60	3	Dry	Enamel	113
2	No wipe	29	60	3	Oily	Enamel	114
2	No wipe	29	60	3	Dry	Latex	115
2	No wipe	29	60	3	Oily	Latex	116
2	Include precleaning test No. 8: oily soil batch 2 on latex						
2	Wipe	30	70	3	Oily	Enamel	117
2	Wipe	30	70	3	Dry	Enamel	118
2	Wipe	30	70	3	Oily	Latex	119
2	Wipe	30	70	3	Dry	Latex	120
2	No wipe	31	60	11	Dry	Latex	121
2	No wipe	31	60	11	Oily	Latex	122
2	No wipe	31	60	11	Oily	Enamel	123
2	No wipe	31	60	11	Dry	Enamel	124
2	Wipe	32	30	11	Oily	Enamel	125
2	Wipe	32	30	11	Oily	Latex	126
2	Wipe	32	30	11	Dry	Latex	127
2	Wipe	32	30	11	Dry	Enamel	128

Appendix B

Laboratory Data—Test and QC Samples

Laboratory data for 723 (test and laboratory QC) samples are presented in this appendix. Data for the 598 instrument QC samples are not shown here. The data are organized by analytical instrument file name (total of 15), and within each instrument file by analytical run number (i.e., analysis sequence). Page breaks occur after each instrumental file. The data tables were generated in SAS with the following headers:

SAS variable name	Definition (unit)
OBS	Running observation number (1 through 723)
MATRIX	Matrix (wipe, sponge, core, liquid)
INSTRMNT	Analytical instrument (ICP or GFAA)
PREPBTCH	Analytical preparation batch number
RUN_NO	Analytical run number (starts over within each instrument file)
QC_ID	QC ID code: Test, MB, MMB, LCS, or SRM
LAB_ID	Laboratory ID
SAMPLEID	Sample ID; these relate to the coupons generated in the "test " (coupon preparation laboratory). The following 5 variables are subparts of this variable.
SUBSTRAT	Substrate (enamel or latex)
CLMIX	Cleaning solution number (01 through 32)
SOILTYPE	Soil type (D=dry; L=oily)
SOILBTCH	Soil batch number (1 or 2)
SMPLTYPE	Sample type (all Ws=wipe; CR=core; SP=sponge; RR=rod rinse)
MIL	mL of soil applied to coupons (2 mL on enamel; 4 mL on latex)
C	Comment indicating whether the amount of lead is below detection limit
AMOUNT	Total amount of lead per sample, in µg. Note that the amounts for core samples are not corrected for total soiled coupon surface.
SRMREC	Percent recovery; applies to SRM and LCS only.

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OBS	MATRIX	INSTRMNT	PREPBTCH	RUN_NO	QC_ID	LAB_ID	SAMPLEID	SUBSTRAT	CLMIX	SOILTYPE	SOILBTCH	SMPLTYPE	MIL	C	AMOUNT	SRMREC
1	WIPE	ICP	4816-8B	23	FIELD	2280	PL12D1WW	ENAMEL	12	D	1	WW	2		5.97	.
2	WIPE	ICP	4816-8B	24	FIELD	2281	LF12D1WW	LATEX	12	D	1	WW	4		52.93	.
3	WIPE	ICP	4816-8B	25	FIELD	2282	PL12L1WW	ENAMEL	12	L	1	WW	2		14.55	.
4	WIPE	ICP	4816-8B	26	FIELD	2283	LF12L1WW	LATEX	12	L	1	WW	4		37.68	.
5	WIPE	ICP	4816-8B	27	FIELD	2284	PL14D1WW	ENAMEL	14	D	1	WW	2		4.27	.
6	WIPE	ICP	4816-8B	28	FIELD	2285	LF14D1WW	LATEX	14	D	1	WW	4		24.67	.
7	WIPE	ICP	4816-8B	29	FIELD	2286	PL14L1WW	ENAMEL	14	L	1	WW	2		11.82	.
8	WIPE	ICP	4816-8B	30	FIELD	2287	LF14L1WW	LATEX	14	L	1	WW	4		49.27	.
9	WIPE	ICP	4816-8B	31	FIELD	2288	PL16D1WW	ENAMEL	16	D	1	WW	2		15.85	.
10	WIPE	ICP	4816-8B	32	FIELD	2289	LF16D1WW	LATEX	16	D	1	WW	4		24.92	.
11	WIPE	ICP	4816-8B	38	FIELD	2290	PL16L1WW	ENAMEL	16	L	1	WW	2		17.80	.
12	WIPE	ICP	4816-8B	39	FIELD	2291	LF16L1WW	LATEX	16	L	1	WW	4		54.92	.
13	WIPE	ICP	4816-8B	40	FIELD	2292	PL16D0WW	ENAMEL	16	D	0	WW	2	<	3.44	.
14	WIPE	ICP	4816-8B	41	FIELD	2293	LF16D0WW	LATEX	16	D	0	WW	4	<	3.44	.
15	WIPE	ICP	4816-8B	42	FIELD	2294	PL19D2WW	ENAMEL	19	D	2	WW	2		7.69	.
16	WIPE	ICP	4816-8B	43	FIELD	2295	LF19D2WW	LATEX	19	D	2	WW	4		49.88	.
17	WIPE	ICP	4816-8B	44	FIELD	2296	PL19L2WW	ENAMEL	19	L	2	WW	2		8.70	.
18	WIPE	ICP	4816-8B	45	FIELD	2297	LF19L2WW	LATEX	19	L	2	WW	4		47.80	.
19	WIPE	ICP	4816-8B	46	FIELD	2326	PL32L0WW	ENAMEL	32	L	0	WW	2	<	3.44	.
20	WIPE	ICP	4816-8B	47	FIELD	2327	LF32L0WW	LATEX	32	L	0	WW	4	<	3.44	.
21	WIPE	ICP	4816-8B	53	LCS	2386	LCS								101.37	101.370
22	WIPE	ICP	4816-8B	54	MMB	2387	MMB							<	3.44	.
23	WIPE	ICP	4816-8B	55	SRM 2710	2401 DF5	SRM 2710								4394.75	78.717
24	WIPE	ICP	4816-8B	56	MB	2421	MB							<	3.44	.
25	WIPE	ICP	4816-17	57	FIELD	2330	PCPLL1W1	ENAMEL		L	1	W1	2		641.24	.
26	WIPE	ICP	4816-17	58	FIELD	2331	PCPLL1W2	ENAMEL		L	1	W2	2		16.51	.
27	WIPE	ICP	4816-17	59	FIELD	2335	PCLFL1W1	LATEX		L	1	W1	4		1119.60	.
28	WIPE	ICP	4816-17	60	FIELD	2336	PCLFL1W2	LATEX		L	1	W2	4		124.99	.
29	WIPE	ICP	4816-17	61	FIELD	2340	PCLFD1W1	LATEX		D	1	W1	4		1399.90	.
30	WIPE	ICP	4816-17	62	FIELD	2341	PCLFD1W2	LATEX		D	1	W2	4		63.50	.
31	WIPE	ICP	4816-17	70	FIELD	2345	PCPLD1W1	ENAMEL		D	1	W1	2		759.86	.
32	WIPE	ICP	4816-17	71	FIELD	2346	PCPLD1W2	ENAMEL		D	1	W2	2		21.04	.
33	WIPE	ICP	4816-17	72	FIELD	2350	PCLFD2W1	LATEX		D	2	W1	4		1480.10	.
34	WIPE	ICP	4816-17	73	FIELD	2351	PCLFD2W2	LATEX		D	2	W2	4		136.65	.
35	WIPE	ICP	4816-17	74	FIELD	2355	PCPLD2W1	ENAMEL		D	2	W1	2		831.31	.
36	WIPE	ICP	4816-17	75	FIELD	2356	PCPLD2W2	ENAMEL		D	2	W2	2		93.74	.
37	WIPE	ICP	4816-17	76	FIELD	2360	PCPLL2W1	ENAMEL		L	2	W1	2		764.21	.
38	WIPE	ICP	4816-17	77	FIELD	2361	PCPLL2W2	ENAMEL		L	2	W2	2		37.72	.
39	WIPE	ICP	4816-17	78	FIELD	2365	PCLFL2W1	LATEX		L	2	W1	4		1549.10	.
40	WIPE	ICP	4816-17	79	FIELD	2366	PCLFL2W2	LATEX		L	2	W2	4		126.30	.
41	WIPE	ICP	4816-17	85	SRM 2710	2437 DF5	SRM 2710								5682.00	102.600
42	WIPE	ICP	4816-17	86	MMB	2439	MMB							<	3.44	.
43	WIPE	ICP	4816-17	87	MB	2440	MB								29.36	.
44	WIPE	ICP	4816-17	88	LCS	2441	LCS							<	3.44	3.441
45	WIPE	ICP	4816-12	89	FIELD	2298	PL21D2WW	ENAMEL	21	D	2	WW	2		16.26	.
46	WIPE	ICP	4816-12	90	FIELD	2299	LF21D2WW	LATEX	21	D	2	WW	4		29.82	.
47	WIPE	ICP	4816-12	91	FIELD	2300	PL21L2WW	ENAMEL	21	L	2	WW	2		31.16	.
48	WIPE	ICP	4816-12	92	FIELD	2301	LF21L2WW	LATEX	21	L	2	WW	4		51.40	.
49	WIPE	ICP	4816-12	93	FIELD	2302	PL22D2WW	ENAMEL	22	D	2	WW	2		5.96	.
50	WIPE	ICP	4816-12	94	FIELD	2303	LF22D2WW	LATEX	22	D	2	WW	4		39.81	.
51	WIPE	ICP	4816-12	102	FIELD	2304	PL22L2WW	ENAMEL	22	L	2	WW	2		9.49	.
52	WIPE	ICP	4816-12	103	FIELD	2305	LF22L2WW	LATEX	22	L	2	WW	4		25.20	.
53	WIPE	ICP	4816-12	104	FIELD	2306	PL26D2WW	ENAMEL	26	D	2	WW	2	<	3.44	.

IFILE=E08097A
(continued)

OBS	MATRIX	INSTRMNT	PREPBTCH	RUN_NO	QC_ID	LAB_ID	SAMPLEID	SUBSTRAT	CLMIX	SOILTYPE	SOILBTCH	SMPLTYPE	MIL	C	AMOUNT	SRMREC
54	WIPE	ICP	4816-12	105	FIELD	2307	LF26D2WW	LATEX	26	D	2	WW	4		28.24	.
55	WIPE	ICP	4816-12	106	FIELD	2308	PL26L2WW	ENAMEL	26	L	2	WW	2		11.27	.
56	WIPE	ICP	4816-12	107	FIELD	2309	LF26L2WW	LATEX	26	L	2	WW	4		63.58	.
57	WIPE	ICP	4816-12	108	FIELD	2398	LF12D1WW2	LATEX	12	D	1	WW2	4		23.82	.
58	WIPE	ICP	4816-12	109	FIELD	2399	LF12L1WW2	LATEX	12	L	1	WW2	4		16.37	.
59	WIPE	ICP	4816-12	115	LCS	2388	LCS								95.03	95.026
60	WIPE	ICP	4816-12	116	SRM 2710	2430 DF5	SRM 2710								5925.50	106.881
61	WIPE	ICP	4816-12	117	MMB	2433	MMB							<	3.44	.
62	WIPE	ICP	4816-12	118	MB	2434	MB							<	3.44	.

-- IFILE=E08107A --

OBS	MATRIX	INSTRMNT	PREPBTCH	RUN_NO	QC_ID	LAB_ID	SAMPLEID	SUBSTRAT	CLMIX	SOILTYPE	SOILBTCH	SMPLTYPE	MIL	C	AMOUNT	SRMREC
63	WIPE	ICP	4816-13	23	FIELD	2310	PL27D2WW	ENAMEL	27	D	2	WW	2		15.38	.
64	WIPE	ICP	4816-13	24	FIELD	2311	LF27D2WW	LATEX	27	D	2	WW	4		46.10	.
65	WIPE	ICP	4816-13	25	FIELD	2312	PL27L2WW	ENAMEL	27	L	2	WW	2		27.89	.
66	WIPE	ICP	4816-13	26	FIELD	2313	LF27L2WW	LATEX	27	L	2	WW	4		67.70	.
67	WIPE	ICP	4816-13	27	FIELD	2314	PL28D2WW	ENAMEL	28	D	2	WW	2		3.13	.
68	WIPE	ICP	4816-13	28	FIELD	2315	LF28D2WW	LATEX	28	D	2	WW	4		18.89	.
69	WIPE	ICP	4816-13	29	FIELD	2316	PL28L2WW	ENAMEL	28	L	2	WW	2		13.49	.
70	WIPE	ICP	4816-13	30	FIELD	2317	LF28L2WW	LATEX	28	L	2	WW	4		35.41	.
71	WIPE	ICP	4816-13	31	FIELD	2318	PL30D2WW	ENAMEL	30	D	2	WW	2		6.07	.
72	WIPE	ICP	4816-13	32	FIELD	2319	LF30D2WW	LATEX	30	D	2	WW	4		24.73	.
73	WIPE	ICP	4816-13	38	FIELD	2320	PL30L2WW	ENAMEL	30	L	2	WW	2		12.64	.
74	WIPE	ICP	4816-13	39	FIELD	2321	LF30L2WW	LATEX	30	L	2	WW	4		24.85	.
75	WIPE	ICP	4816-13	40	FIELD	2322	PL32D2WW	ENAMEL	32	D	2	WW	2		4.33	.
76	WIPE	ICP	4816-13	41	FIELD	2323	LF32D2WW	LATEX	32	D	2	WW	4		18.80	.
77	WIPE	ICP	4816-13	42	FIELD	2324	PL32L2WW	ENAMEL	32	L	2	WW	2		4.60	.
78	WIPE	ICP	4816-13	43	FIELD	2325	LF32L2WW	LATEX	32	L	2	WW	4		19.64	.
79	WIPE	ICP	4816-13	44	MMB	2389	MMB								2.46	.
80	WIPE	ICP	4816-13	45	SRM 2710	2431 DF5	SRM 2710								5222.50	94.2009
81	WIPE	ICP	4816-13	46	LCS	2435	LCS								93.11	93.1130
82	WIPE	ICP	4816-13	47	MB	2436	MB							<	2.24	.
83	WIPE	ICP	4816-8A	55	FIELD	2260	PL01D1WW	ENAMEL	01	D	1	WW	2		12.57	.
84	WIPE	ICP	4816-8A	56	FIELD	2261	LF01D1WW	LATEX	01	D	1	WW	4		32.08	.
85	WIPE	ICP	4816-8A	57	FIELD	2262	PL01L1WW	ENAMEL	01	L	1	WW	2		27.85	.
86	WIPE	ICP	4816-8A	58	FIELD	2263	LF01L1WW	LATEX	01	L	1	WW	4		61.67	.
87	WIPE	ICP	4816-8A	59	FIELD	2264	PL03D1WW	ENAMEL	03	D	1	WW	2		12.80	.
88	WIPE	ICP	4816-8A	60	FIELD	2265	LF03D1WW	LATEX	03	D	1	WW	4		55.55	.
89	WIPE	ICP	4816-8A	61	FIELD	2266	PL03L1WW	ENAMEL	03	L	1	WW	2		33.57	.
90	WIPE	ICP	4816-8A	62	FIELD	2267	LF03L1WW	LATEX	03	L	1	WW	4		47.47	.
91	WIPE	ICP	4816-8A	63	FIELD	2268	PL05D1WW	ENAMEL	05	D	1	WW	2		10.01	.
92	WIPE	ICP	4816-8A	64	FIELD	2269	LF05D1WW	LATEX	05	D	1	WW	4		59.73	.
93	WIPE	ICP	4816-8A	70	FIELD	2270	PL05L1WW	ENAMEL	05	L	1	WW	2		19.15	.
94	WIPE	ICP	4816-8A	71	FIELD	2271	LF05L1WW	LATEX	05	L	1	WW	4		46.20	.
95	WIPE	ICP	4816-8A	72	FIELD	2272	PL06D1WW	ENAMEL	06	D	1	WW	2		6.29	.
96	WIPE	ICP	4816-8A	73	FIELD	2273	LF06D1WW	LATEX	06	D	1	WW	4		49.21	.
97	WIPE	ICP	4816-8A	74	FIELD	2274	PL06L1WW	ENAMEL	06	L	1	WW	2		13.77	.
98	WIPE	ICP	4816-8A	75	FIELD	2275	LF06L1WW	LATEX	06	L	1	WW	4		66.45	.
99	WIPE	ICP	4816-8A	76	FIELD	2276	PL11D1WW	ENAMEL	11	D	1	WW	2		4.88	.
100	WIPE	ICP	4816-8A	77	FIELD	2277	LF11D1WW	LATEX	11	D	1	WW	4		37.57	.
101	WIPE	ICP	4816-8A	78	FIELD	2278	PL11L1WW	ENAMEL	11	L	1	WW	2		8.86	.
102	WIPE	ICP	4816-8A	79	FIELD	2279	LF11L1WW	LATEX	11	L	1	WW	4		21.41	.
103	WIPE	ICP	4816-8A	85	LCS	2384	LCS								98.68	98.6790
104	WIPE	ICP	4816-8A	86	MMB	2385	MMB							<	2.24	.
105	WIPE	ICP	4816-8A	87	SRM 2710	2402 DF5	SRM 2710								5303.00	95.4807
106	WIPE	ICP	4816-8A	88	MB	2420	MB							<	2.24	.

-- IFILE=E08167A RUN 1 --

OBS	MATRIX	INSTRMNT	PREPBTCH	RUN_NO	QC_ID	LAB_ID	SAMPLEID	SUBSTRAT	CLMIX	SOILTYPE	SOILBTCH	SMPLTYPE	MIL	C	AMOUNT	SRMREC
107	SPONGE	ICP	4816-16	23	FIELD	2028	PL11D1SP	ENAMEL	11	D	1	SP	2		572.61	.
108	SPONGE	ICP	4816-16	24	FIELD	2029	LF11D1SP	LATEX	11	D	1	SP	4		1135.80	.
109	SPONGE	ICP	4816-16	25	FIELD	2030	PL11L1SP	ENAMEL	11	L	1	SP	2		549.20	.
110	SPONGE	ICP	4816-16	26	FIELD	2031	LF11L1SP	LATEX	11	L	1	SP	4		872.28	.
111	SPONGE	ICP	4816-16	27	FIELD	2032	PL12D1SP	ENAMEL	12	D	1	SP	2		696.63	.
112	SPONGE	ICP	4816-16	28	FIELD	2033	LF12D1SP	LATEX	12	D	1	SP	4		1281.40	.
113	SPONGE	ICP	4816-16	29	FIELD	2034	PL12L1SP	ENAMEL	12	L	1	SP	2		596.00	.
114	SPONGE	ICP	4816-16	30	FIELD	2035	LF12L1SP	LATEX	12	L	1	SP	4		904.09	.
115	SPONGE	ICP	4816-16	31	FIELD	2036	PL13D1SP	ENAMEL	13	D	1	SP	2		651.28	.
116	SPONGE	ICP	4816-16	32	FIELD	2037	LF13D1SP	LATEX	13	D	1	SP	4		1177.80	.
117	SPONGE	ICP	4816-16	38	FIELD	2038	PL13L1SP	ENAMEL	13	L	1	SP	2		507.92	.
118	SPONGE	ICP	4816-16	39	FIELD	2039	LF13L1SP	LATEX	13	L	1	SP	4		668.93	.
119	SPONGE	ICP	4816-16	40	FIELD	2040	PL14D1SP	ENAMEL	14	D	1	SP	2		514.53	.
120	SPONGE	ICP	4816-16	41	FIELD	2041	LF14D1SP	LATEX	14	D	1	SP	4		1492.10	.
121	SPONGE	ICP	4816-16	42	FIELD	2042	PL14L1SP	ENAMEL	14	L	1	SP	2		676.96	.
122	SPONGE	ICP	4816-16	43	FIELD	2043	LF14L1SP	LATEX	14	L	1	SP	4		1063.70	.
123	SPONGE	ICP	4816-16	44	FIELD	2044	PL15D1SP	ENAMEL	15	D	1	SP	2		665.18	.
124	SPONGE	ICP	4816-16	45	FIELD	2045	LF15D1SP	LATEX	15	D	1	SP	4		1297.40	.
125	SPONGE	ICP	4816-16	46	FIELD	2046	PL15L1SP	ENAMEL	15	L	1	SP	2		653.78	.
126	SPONGE	ICP	4816-16	47	FIELD	2047	LF15L1SP	LATEX	15	L	1	SP	4		1076.20	.
127	SPONGE	ICP	4816-16	55	MMB	2405	MMB								2.98	.
128	SPONGE	ICP	4816-16	56	LCS	2406	LCS								94.06	94.062
129	SPONGE	ICP	4816-16	57	SRM 2710	2407 DF5	SRM 2710								5248.00	94.473
130	SPONGE	ICP	4816-16	58	MB	2438	MB							<	2.65	.
131	SPONGE	ICP	4816-11	59	FIELD	2008	PL06D1SP	ENAMEL	06	D	1	SP	2		611.45	.
132	SPONGE	ICP	4816-11	60	FIELD	2009	LF06D1SP	LATEX	06	D	1	SP	4		1193.40	.
133	SPONGE	ICP	4816-11	61	FIELD	2010	PL06L1SP	ENAMEL	06	L	1	SP	2		514.62	.
134	SPONGE	ICP	4816-11	62	FIELD	2011	LF06L1SP	LATEX	06	L	1	SP	4		925.00	.
135	SPONGE	ICP	4816-11	63	FIELD	2012	PL07D1SP	ENAMEL	07	D	1	SP	2		753.07	.
136	SPONGE	ICP	4816-11	64	FIELD	2013	LF07D1SP	LATEX	07	D	1	SP	4		1286.60	.
137	SPONGE	ICP	4816-11	70	FIELD	2014	PL07L1SP	ENAMEL	07	L	1	SP	2		604.65	.
138	SPONGE	ICP	4816-11	71	FIELD	2015	LF07L1SP	LATEX	07	L	1	SP	4		1130.10	.
139	SPONGE	ICP	4816-11	72	FIELD	2016	PL08D1SP	ENAMEL	08	D	1	SP	2		688.82	.
140	SPONGE	ICP	4816-11	73	FIELD	2017	LF08D1SP	LATEX	08	D	1	SP	4		1260.40	.
141	SPONGE	ICP	4816-11	74	FIELD	2018	PL08L1SP	ENAMEL	08	L	1	SP	2		583.39	.
142	SPONGE	ICP	4816-11	75	FIELD	2019	LF08L1SP	LATEX	08	L	1	SP	4		687.69	.
143	SPONGE	ICP	4816-11	76	FIELD	2020	PL09D1SP	ENAMEL	09	D	1	SP	2		726.32	.
144	SPONGE	ICP	4816-11	77	FIELD	2021	LF09D1SP	LATEX	09	D	1	SP	4		1247.90	.
145	SPONGE	ICP	4816-11	78	FIELD	2022	PL09L1SP	ENAMEL	09	L	1	SP	2		751.93	.
146	SPONGE	ICP	4816-11	79	FIELD	2023	LF09L1SP	LATEX	09	L	1	SP	4		1180.00	.
147	SPONGE	ICP	4816-11	87	FIELD	2024	PL10D1SP	ENAMEL	10	D	1	SP	2		773.54	.
148	SPONGE	ICP	4816-11	88	FIELD	2025	LF10D1SP	LATEX	10	D	1	SP	4		1605.70	.
149	SPONGE	ICP	4816-11	89	FIELD	2026	PL10L1SP	ENAMEL	10	L	1	SP	2		674.43	.
150	SPONGE	ICP	4816-11	90	FIELD	2027	LF10L1SP	LATEX	10	L	1	SP	4		1068.30	.
151	SPONGE	ICP	4816-11	91	LCS	2371	LCS								100.12	100.120
152	SPONGE	ICP	4816-11	92	MMB	2403	MMB								3.37	.
153	SPONGE	ICP	4816-11	93	SRM 2710	2404 DF5	SRM 2710								5285.00	94.798
154	SPONGE	ICP	4816-11	94	MB	2432	MB							<	2.65	.
155	SPONGE	ICP	4816-5	95	FIELD	1988	PL01D1SP	ENAMEL	01	D	1	SP	2		663.43	.
156	SPONGE	ICP	4816-5	96	FIELD	1989	LF01D1SP	LATEX	01	D	1	SP	4		1397.90	.
157	SPONGE	ICP	4816-5	102	FIELD	1990	PL01L1SP	ENAMEL	01	L	1	SP	2		587.65	.
158	SPONGE	ICP	4816-5	103	FIELD	1991	LF01L1SP	LATEX	01	L	1	SP	4		1013.00	.
159	SPONGE	ICP	4816-5	104	FIELD	1992	PL02D1SP	ENAMEL	02	D	1	SP	2		713.29	.

IFILE=E08167A RUN 1
(continued)

OBS	MATRIX	INSTRMNT	PREPBTCH	RUN_NO	QC_ID	LAB_ID	SAMPLEID	SUBSTRAT	CLMIX	SOILTYPE	SOILBTCH	SMPLTYPE	MIL C	AMOUNT	SRMREC
160	SPONGE	ICP	4816-5	105	FIELD	1993	LF02D1SP	LATEX	02	D	1	SP	4	1402.00	.
161	SPONGE	ICP	4816-5	106	FIELD	1994	PL02L1SP	ENAMEL	02	L	1	SP	2	566.32	.
162	SPONGE	ICP	4816-5	107	FIELD	1995	LF02L1SP	LATEX	02	L	1	SP	4	1107.70	.
163	SPONGE	ICP	4816-5	108	FIELD	1996	PL03D1SP	ENAMEL	03	D	1	SP	2	669.41	.
164	SPONGE	ICP	4816-5	109	FIELD	1997	LF03D1SP	LATEX	03	D	1	SP	4	1062.50	.
165	SPONGE	ICP	4816-5	110	FIELD	1998	PL03L1SP	ENAMEL	03	L	1	SP	2	610.01	.
166	SPONGE	ICP	4816-5	111	FIELD	1999	LF03L1SP	LATEX	03	L	1	SP	4	1186.90	.
167	SPONGE	ICP	4816-5	119	FIELD	2000	PL04D1SP	ENAMEL	04	D	1	SP	2	931.32	.
168	SPONGE	ICP	4816-5	120	FIELD	2001	LF04D1SP	LATEX	04	D	1	SP	4	1342.10	.
169	SPONGE	ICP	4816-5	121	FIELD	2002	PL04L1SP	ENAMEL	04	L	1	SP	2	646.82	.
170	SPONGE	ICP	4816-5	122	FIELD	2003	LF04L1SP	LATEX	04	L	1	SP	4	1151.50	.
171	SPONGE	ICP	4816-5	123	FIELD	2004	PL05D1SP	ENAMEL	05	D	1	SP	2	868.78	.
172	SPONGE	ICP	4816-5	124	FIELD	2005	LF05D1SP	LATEX	05	D	1	SP	4	1549.80	.
173	SPONGE	ICP	4816-5	125	FIELD	2006	PL05L1SP	ENAMEL	05	L	1	SP	2	633.83	.
174	SPONGE	ICP	4816-5	126	FIELD	2007	LF05L1SP	LATEX	05	L	1	SP	4	1230.30	.
175	SPONGE	ICP	4816-5	132	SRM 2710	2368 DF5	SRM 2710							5138.50	92.5522
176	SPONGE	ICP	4816-5	133	MMB	2369	MMB							2.96	.
177	SPONGE	ICP	4816-5	134	LCS	2370	LCS							99.60	99.5990
178	SPONGE	ICP	4816-5	135	MB	2400	MB							3.28	.

-- IFILE=E08167A RUN 2 --

OBS	MATRIX	INSTRMNT	PREPBTCH	RUN_NO	QC_ID	LAB_ID	SAMPLEID	SUBSTRAT	CLMIX	SOILTYPE	SOILBTCH	SMPLTYPE	MIL	C	AMOUNT	SRMREC
179	SPONGE	ICP	4816-23	24	FIELD	2048	PL16D1SP	ENAMEL	16	D	1	SP	2		742.34	.
180	SPONGE	ICP	4816-23	25	FIELD	2049	LF16D1SP	LATEX	16	D	1	SP	4		1364.80	.
181	SPONGE	ICP	4816-23	26	FIELD	2050	PL16L1SP	ENAMEL	16	L	1	SP	2		605.81	.
182	SPONGE	ICP	4816-23	27	FIELD	2051	LF16L1SP	LATEX	16	L	1	SP	4		1131.30	.
183	SPONGE	ICP	4816-23	28	FIELD	2052	PL16D0SP	ENAMEL	16	D	0	SP	2		128.68	.
184	SPONGE	ICP	4816-23	29	FIELD	2053	LF16D0SP	LATEX	16	D	0	SP	4	<	7.39	.
185	SPONGE	ICP	4816-23	30	FIELD	2054	PL16L0SP	ENAMEL	16	L	0	SP	2	<	7.39	.
186	SPONGE	ICP	4816-23	31	FIELD	2055	LF16L0SP	LATEX	16	L	0	SP	4		11.73	.
187	SPONGE	ICP	4816-23	32	FIELD	2056	PL17D2SP	ENAMEL	17	D	2	SP	2		725.49	.
188	SPONGE	ICP	4816-23	33	FIELD	2057	LF17D2SP	LATEX	17	D	2	SP	4		1335.10	.
189	SPONGE	ICP	4816-23	39	FIELD	2058	PL17L2SP	ENAMEL	17	L	2	SP	2		775.09	.
190	SPONGE	ICP	4816-23	40	FIELD	2059	LF17L2SP	LATEX	17	L	2	SP	4		1145.40	.
191	SPONGE	ICP	4816-23	41	FIELD	2060	PL18D2SP	ENAMEL	18	D	2	SP	2		756.66	.
192	SPONGE	ICP	4816-23	42	FIELD	2061	LF18D2SP	LATEX	18	D	2	SP	4		1346.40	.
193	SPONGE	ICP	4816-23	43	FIELD	2062	PL18L2SP	ENAMEL	18	L	2	SP	2		751.23	.
194	SPONGE	ICP	4816-23	44	FIELD	2063	LF18L2SP	LATEX	18	L	2	SP	4		1316.90	.
195	SPONGE	ICP	4816-23	45	FIELD	2064	PL19D2SP	ENAMEL	19	D	2	SP	2		761.99	.
196	SPONGE	ICP	4816-23	46	FIELD	2065	LF19D2SP	LATEX	19	D	2	SP	4		1420.30	.
197	SPONGE	ICP	4816-23	47	FIELD	2066	PL19L2SP	ENAMEL	19	L	2	SP	2		811.38	.
198	SPONGE	ICP	4816-23	48	FIELD	2067	LF19L2SP	LATEX	19	L	2	SP	4		1415.10	.
199	SPONGE	ICP	4816-23	54	MMB	2408	MMB								20.99	.
200	SPONGE	ICP	4816-23	55	LCS	2416	LCS								91.26	91.2590
201	SPONGE	ICP	4816-23	56	SRM 2710	2418 DF5	SRM 2710								5369.50	96.5043
202	SPONGE	ICP	4816-23	57	MB	2445	MB							<	7.39	.
203	SPONGE	ICP	4816-24	58	FIELD	2068	PL20D2SP	ENAMEL	20	D	2	SP	2		699.03	.
204	SPONGE	ICP	4816-24	59	FIELD	2069	LF20D2SP	LATEX	20	D	2	SP	4		1316.80	.
205	SPONGE	ICP	4816-24	60	FIELD	2070	PL20L2SP	ENAMEL	20	L	2	SP	2		668.26	.
206	SPONGE	ICP	4816-24	61	FIELD	2071	LF20L2SP	LATEX	20	L	2	SP	4		1137.60	.
207	SPONGE	ICP	4816-24	62	FIELD	2072	PL21D2SP	ENAMEL	21	D	2	SP	2		755.74	.
208	SPONGE	ICP	4816-24	63	FIELD	2073	LF21D2SP	LATEX	21	D	2	SP	4		1341.30	.
209	SPONGE	ICP	4816-24	71	FIELD	2074	PL21L2SP	ENAMEL	21	L	2	SP	2		732.92	.
210	SPONGE	ICP	4816-24	72	FIELD	2075	LF21L2SP	LATEX	21	L	2	SP	4		1146.90	.
211	SPONGE	ICP	4816-24	73	FIELD	2076	PL22D2SP	ENAMEL	22	D	2	SP	2		589.31	.
212	SPONGE	ICP	4816-24	74	FIELD	2077	LF22D2SP	LATEX	22	D	2	SP	4		1381.80	.
213	SPONGE	ICP	4816-24	75	FIELD	2078	PL22L2SP	ENAMEL	22	L	2	SP	2		783.91	.
214	SPONGE	ICP	4816-24	76	FIELD	2079	LF22L2SP	LATEX	22	L	2	SP	4		1162.70	.
215	SPONGE	ICP	4816-24	77	FIELD	2080	PL23D2SP	ENAMEL	23	D	2	SP	2		705.38	.
216	SPONGE	ICP	4816-24	78	FIELD	2081	LF23D2SP	LATEX	23	D	2	SP	4		1399.10	.
217	SPONGE	ICP	4816-24	79	FIELD	2082	PL23L2SP	ENAMEL	23	L	2	SP	2		723.76	.
218	SPONGE	ICP	4816-24	80	FIELD	2083	LF23L2SP	LATEX	23	L	2	SP	4		1280.70	.
219	SPONGE	ICP	4816-24	86	FIELD	2084	PL24D2SP	ENAMEL	24	D	2	SP	2		666.97	.
220	SPONGE	ICP	4816-24	87	FIELD	2085	LF24D2SP	LATEX	24	D	2	SP	4		1373.90	.
221	SPONGE	ICP	4816-24	88	FIELD	2086	PL24L2SP	ENAMEL	24	L	2	SP	2		740.42	.
222	SPONGE	ICP	4816-24	89	FIELD	2087	LF24L2SP	LATEX	24	L	2	SP	4		1181.60	.
223	SPONGE	ICP	4816-24	90	LCS	2413	LCS								88.41	88.4090
224	SPONGE	ICP	4816-24	91	SRM 2710	2415 DF5	SRM 2710								5455.50	98.4925
225	SPONGE	ICP	4816-24	92	MMB	2417	MMB							<	7.39	.
226	SPONGE	ICP	4816-24	93	MB	2446	MB							<	7.39	.

IFILE=E08187A

OBS	MATRIX	INSTRMNT	PREPBTCH	RUN_NO	QC_ID	LAB_ID	SAMPLEID	SUBSTRAT	CLMIX	SOILTYPE	SOILBTCH	SMPLTYPE	MIL	C	AMOUNT	SRMREC
227	SPONGE	ICP	4816-29	55	FIELD	2088	PL25D2SP	ENAMEL	25	D	2	SP	2		411.19	.
228	SPONGE	ICP	4816-29	56	FIELD	2089	LF25D2SP	LATEX	25	D	2	SP	4		1178.00	.
229	SPONGE	ICP	4816-29	57	FIELD	2090	PL25L2SP	ENAMEL	25	L	2	SP	2		473.50	.
230	SPONGE	ICP	4816-29	58	FIELD	2091	LF25L2SP	LATEX	25	L	2	SP	4		1135.90	.
231	SPONGE	ICP	4816-29	59	FIELD	2092	PL26D2SP	ENAMEL	26	D	2	SP	2		717.80	.
232	SPONGE	ICP	4816-29	60	FIELD	2093	LF26D2SP	LATEX	26	D	2	SP	4		1335.20	.
233	SPONGE	ICP	4816-29	61	FIELD	2094	PL26L2SP	ENAMEL	26	L	2	SP	2		643.87	.
234	SPONGE	ICP	4816-29	62	FIELD	2095	LF26L2SP	LATEX	26	L	2	SP	4		742.64	.
235	SPONGE	ICP	4816-29	70	FIELD	2096	PL27D2SP	ENAMEL	27	D	2	SP	2		639.91	.
236	SPONGE	ICP	4816-29	71	FIELD	2097	LF27D2SP	LATEX	27	D	2	SP	4		1342.60	.
237	SPONGE	ICP	4816-29	72	FIELD	2098	PL27L2SP	ENAMEL	27	L	2	SP	2		673.94	.
238	SPONGE	ICP	4816-29	73	FIELD	2099	LF27L2SP	LATEX	27	L	2	SP	4		589.83	.
239	SPONGE	ICP	4816-29	74	FIELD	2100	PL28D2SP	ENAMEL	28	D	2	SP	2		670.01	.
240	SPONGE	ICP	4816-29	75	FIELD	2101	LF28D2SP	LATEX	28	D	2	SP	4		1482.60	.
241	SPONGE	ICP	4816-29	76	FIELD	2102	PL28L2SP	ENAMEL	28	L	2	SP	2		736.71	.
242	SPONGE	ICP	4816-29	77	FIELD	2103	LF28L2SP	LATEX	28	L	2	SP	4		1406.50	.
243	SPONGE	ICP	4816-29	78	FIELD	2104	PL29D2SP	ENAMEL	29	D	2	SP	2		724.01	.
244	SPONGE	ICP	4816-29	79	FIELD	2105	LF29D2SP	LATEX	29	D	2	SP	4		1469.60	.
245	SPONGE	ICP	4816-29	85	FIELD	2106	PL29L2SP	ENAMEL	29	L	2	SP	2		688.27	.
246	SPONGE	ICP	4816-29	86	FIELD	2107	LF29L2SP	LATEX	29	L	2	SP	4		1315.80	.
247	SPONGE	ICP	4816-29	87	MMB	2409	MMB								130.13	.
248	SPONGE	ICP	4816-29	88	LCS	2412	LCS								82.81	82.809
249	SPONGE	ICP	4816-29	89	SRM 2710	2419 DF5	SRM 2710								5763.50	103.884
250	SPONGE	ICP	4816-29	90	MB	2449	MB							<	3.40	.
251	SPONGE	ICP	4816-34	91	FIELD	2108	PL30D2SP	ENAMEL	30	D	2	SP	2		637.36	.
252	SPONGE	ICP	4816-34	92	FIELD	2109	LF30D2SP	LATEX	30	D	2	SP	4		1590.80	.
253	SPONGE	ICP	4816-34	93	FIELD	2110	PL30L2SP	ENAMEL	30	L	2	SP	2		744.25	.
254	SPONGE	ICP	4816-34	94	FIELD	2111	LF30L2SP	LATEX	30	L	2	SP	4		1340.10	.
255	SPONGE	ICP	4816-34	100	FIELD	2112	PL31D2SP	ENAMEL	31	D	2	SP	2		645.62	.
256	SPONGE	ICP	4816-34	101	FIELD	2113	LF31D2SP	LATEX	31	D	2	SP	4		1322.50	.
257	SPONGE	ICP	4816-34	102	FIELD	2114	PL31L2SP	ENAMEL	31	L	2	SP	2		680.40	.
258	SPONGE	ICP	4816-34	103	FIELD	2115	LF31L2SP	LATEX	31	L	2	SP	4		1363.40	.
259	SPONGE	ICP	4816-34	104	FIELD	2116	PL32D2SP	ENAMEL	32	D	2	SP	2		728.28	.
260	SPONGE	ICP	4816-34	105	FIELD	2117	LF32D2SP	LATEX	32	D	2	SP	4		1406.00	.
261	SPONGE	ICP	4816-34	106	FIELD	2118	PL32L2SP	ENAMEL	32	L	2	SP	2		769.57	.
262	SPONGE	ICP	4816-34	107	FIELD	2119	LF32L2SP	LATEX	32	L	2	SP	4		1239.30	.
263	SPONGE	ICP	4816-34	108	FIELD	2120	PL32D0SP	ENAMEL	32	D	0	SP	2	<	3.40	.
264	SPONGE	ICP	4816-34	114	FIELD	2121	LF32D0SP	LATEX	32	D	0	SP	4	<	3.40	.
265	SPONGE	ICP	4816-34	115	FIELD	2122	PL32L0SP	ENAMEL	32	L	0	SP	2		11.02	.
266	SPONGE	ICP	4816-34	116	FIELD	2123	LF32L0SP	LATEX	32	L	0	SP	4		70.63	.
267	SPONGE	ICP	4816-34	117	MMB	2410	MMB							<	3.40	.
268	SPONGE	ICP	4816-34	118	SRM 2710	2411 DF5	SRM 2710								5541.50	99.363
269	SPONGE	ICP	4816-34	119	SRM 2710	2414 DF5	SRM 2710								5211.50	93.715
270	SPONGE	ICP	4816-34	120	MB	2453	MB							<	3.40	.

IFILE=E08227A

OBS	MATRIX	INSTRMNT	PREPBTCH	RUN_NO	QC_ID	LAB_ID	SAMPLEID	SUBSTRAT	CLMIX	SOILTYPE	SOILBTCH	SMPLTYPE	MIL	C	AMOUNT	SRMREC
271	CORE	ICP	4816-18	23	FIELD	2124	PL01D1CR	ENAMEL	01	D	1	CR	2		6.93	.
272	CORE	ICP	4816-18	24	FIELD	2125	LF01D1CR	LATEX	01	D	1	CR	4		7.08	.
273	CORE	ICP	4816-18	25	FIELD	2126	PL01L1CR	ENAMEL	01	L	1	CR	2		8.48	.
274	CORE	ICP	4816-18	26	FIELD	2127	LF01L1CR	LATEX	01	L	1	CR	4		8.07	.
275	CORE	ICP	4816-18	27	FIELD	2128	PL02D1CR	ENAMEL	02	D	1	CR	2		4.59	.
276	CORE	ICP	4816-18	28	FIELD	2129	LF02D1CR	LATEX	02	D	1	CR	4		7.13	.
277	CORE	ICP	4816-18	29	FIELD	2130	PL02L1CR	ENAMEL	02	L	1	CR	2		6.18	.
278	CORE	ICP	4816-18	30	FIELD	2131	LF02L1CR	LATEX	02	L	1	CR	4		6.58	.
279	CORE	ICP	4816-18	31	FIELD	2132	PL03D1CR	ENAMEL	03	D	1	CR	2		5.53	.
280	CORE	ICP	4816-18	32	FIELD	2133	LF03D1CR	LATEX	03	D	1	CR	4		9.44	.
281	CORE	ICP	4816-18	38	FIELD	2134	PL03L1CR	ENAMEL	03	L	1	CR	2		6.32	.
282	CORE	ICP	4816-18	39	FIELD	2135	LF03L1CR	LATEX	03	L	1	CR	4		7.15	.
283	CORE	ICP	4816-18	40	FIELD	2136	PL04D1CR	ENAMEL	04	D	1	CR	2		6.89	.
284	CORE	ICP	4816-18	41	FIELD	2137	LF04D1CR	LATEX	04	D	1	CR	4		7.56	.
285	CORE	ICP	4816-18	42	FIELD	2138	PL04L1CR	ENAMEL	04	L	1	CR	2		4.88	.
286	CORE	ICP	4816-18	43	FIELD	2139	LF04L1CR	LATEX	04	L	1	CR	4		5.08	.
287	CORE	ICP	4816-18	44	FIELD	2140	PL05D1CR	ENAMEL	05	D	1	CR	2		4.16	.
288	CORE	ICP	4816-18	45	FIELD	2141	LF05D1CR	LATEX	05	D	1	CR	4		11.13	.
289	CORE	ICP	4816-18	46	FIELD	2142	PL05L1CR	ENAMEL	05	L	1	CR	2		6.23	.
290	CORE	ICP	4816-18	47	FIELD	2143	LF05L1CR	LATEX	05	L	1	CR	4		6.72	.
291	CORE	ICP	4816-18	53	LCS	2379	LCS								85.98	86.0
292	CORE	ICP	4816-18	54	SRM 2710	2394 DF5	SRM 2710								5240.50	94.6
293	CORE	ICP	4816-18	55	MMB	2424	MMB								7.14	.
294	CORE	ICP	4816-18	56	MB	2442	MB							<	3.73	.
295	CORE	ICP	4816-20	57	FIELD	2144	PL06D1CR	ENAMEL	06	D	1	CR	2		4.37	.
296	CORE	ICP	4816-20	58	FIELD	2145	LF06D1CR	LATEX	06	D	1	CR	4		10.12	.
297	CORE	ICP	4816-20	59	FIELD	2146	PL06L1CR	ENAMEL	06	L	1	CR	2		13.20	.
298	CORE	ICP	4816-20	60	FIELD	2147	LF06L1CR	LATEX	06	L	1	CR	4		7.32	.
299	CORE	ICP	4816-20	61	FIELD	2148	PL07D1CR	ENAMEL	07	D	1	CR	2		6.55	.
300	CORE	ICP	4816-20	62	FIELD	2149	LF07D1CR	LATEX	07	D	1	CR	4		8.28	.
301	CORE	ICP	4816-20	70	FIELD	2150	PL07L1CR	ENAMEL	07	L	1	CR	2		5.17	.
302	CORE	ICP	4816-20	71	FIELD	2151	LF07L1CR	LATEX	07	L	1	CR	4		8.15	.
303	CORE	ICP	4816-20	72	FIELD	2152	PL08D1CR	ENAMEL	08	D	1	CR	2		8.02	.
304	CORE	ICP	4816-20	73	FIELD	2153	LF08D1CR	LATEX	08	D	1	CR	4		11.49	.
305	CORE	ICP	4816-20	74	FIELD	2154	PL08L1CR	ENAMEL	08	L	1	CR	2		6.82	.
306	CORE	ICP	4816-20	75	FIELD	2155	LF08L1CR	LATEX	08	L	1	CR	4		9.78	.
307	CORE	ICP	4816-20	76	FIELD	2156	PL09D1CR	ENAMEL	09	D	1	CR	2		5.09	.
308	CORE	ICP	4816-20	77	FIELD	2157	LF09D1CR	LATEX	09	D	1	CR	4		15.28	.
309	CORE	ICP	4816-20	78	FIELD	2158	PL09L1CR	ENAMEL	09	L	1	CR	2		6.41	.
310	CORE	ICP	4816-20	79	FIELD	2159	LF09L1CR	LATEX	09	L	1	CR	4		9.96	.
311	CORE	ICP	4816-20	85	FIELD	2160	PL10D1CR	ENAMEL	10	D	1	CR	2		6.79	.
312	CORE	ICP	4816-20	86	FIELD	2161	LF10D1CR	LATEX	10	D	1	CR	4		7.55	.
313	CORE	ICP	4816-20	87	FIELD	2162	PL10L1CR	ENAMEL	10	L	1	CR	2		11.63	.
314	CORE	ICP	4816-20	88	FIELD	2163	LF10L1CR	LATEX	10	L	1	CR	4		13.78	.
315	CORE	ICP	4816-20	89	SRM 2710	2376 DF5	SRM 2710								4578.35	82.4
316	CORE	ICP	4816-20	90	MMB	2393	MMB								5.55	.
317	CORE	ICP	4816-20	91	LCS	2428	LCS								85.63	85.6
318	CORE	ICP	4816-20	92	MB	2443	MB								4.15	.
319	CORE	ICP	4816-21	93	FIELD	2164	PL11D1CR	ENAMEL	11	D	1	CR	2		6.09	.
320	CORE	ICP	4816-21	94	FIELD	2165	LF11D1CR	LATEX	11	D	1	CR	4		7.59	.
321	CORE	ICP	4816-21	102	FIELD	2166	PL11L1CR	ENAMEL	11	L	1	CR	2		6.61	.
322	CORE	ICP	4816-21	103	FIELD	2167	LF11L1CR	LATEX	11	L	1	CR	4		5.48	.
323	CORE	ICP	4816-21	104	FIELD	2168	PL12D1CR	ENAMEL	12	D	1	CR	2		7.43	.

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(continued)

OBS	MATRIX	INSTRMNT	PREPBTCH	RUN_NO	QC_ID	LAB_ID	SAMPLEID	SUBSTRAT	CLMIX	SOILTYPE	SOILBTCH	SMPLTYPE	MIL	C	AMOUNT	SRMREC
324	CORE	ICP	4816-21	105	FIELD	2169	LF12D1CR	LATEX	12	D	1	CR	4		7.49	.
325	CORE	ICP	4816-21	106	FIELD	2170	PL12L1CR	ENAMEL	12	L	1	CR	2		7.81	.
326	CORE	ICP	4816-21	107	FIELD	2171	LF12L1CR	LATEX	12	L	1	CR	4		6.24	.
327	CORE	ICP	4816-21	108	FIELD	2172	PL13D1CR	ENAMEL	13	D	1	CR	2		6.04	.
328	CORE	ICP	4816-21	109	FIELD	2173	LF13D1CR	LATEX	13	D	1	CR	4		8.99	.
329	CORE	ICP	4816-21	110	FIELD	2174	PL13L1CR	ENAMEL	13	L	1	CR	2		5.46	.
330	CORE	ICP	4816-21	111	FIELD	2175	LF13L1CR	LATEX	13	L	1	CR	4		11.76	.
331	CORE	ICP	4816-21	117	FIELD	2176	PL14D1CR	ENAMEL	14	D	1	CR	2		8.71	.
332	CORE	ICP	4816-21	118	FIELD	2177	LF14D1CR	LATEX	14	D	1	CR	4		8.34	.
333	CORE	ICP	4816-21	119	FIELD	2178	PL14L1CR	ENAMEL	14	L	1	CR	2		6.23	.
334	CORE	ICP	4816-21	120	FIELD	2179	LF14L1CR	LATEX	14	L	1	CR	4		9.53	.
335	CORE	ICP	4816-21	121	FIELD	2180	PL15D1CR	ENAMEL	15	D	1	CR	2		5.80	.
336	CORE	ICP	4816-21	122	FIELD	2181	LF15D1CR	LATEX	15	D	1	CR	4		9.39	.
337	CORE	ICP	4816-21	123	FIELD	2182	PL15L1CR	ENAMEL	15	L	1	CR	2		5.08	.
338	CORE	ICP	4816-21	124	FIELD	2183	LF15L1CR	LATEX	15	L	1	CR	4		12.03	.
339	CORE	ICP	4816-21	125	LCS	2396	LCS								91.61	91.6
340	CORE	ICP	4816-21	126	MMB	2426	MMB								7.34	.
341	CORE	ICP	4816-21	132	SRM 2710	2429 DF5	SRM 2710								4855.45	87.2
342	CORE	ICP	4816-21	133	MB	2444	MB								5.24	.
343	CORE	ICP	4816-25	134	FIELD	2184	PL16D1CR	ENAMEL	16	D	1	CR	2		5.89	.
344	CORE	ICP	4816-25	135	FIELD	2185	LF16D1CR	LATEX	16	D	1	CR	4		6.40	.
345	CORE	ICP	4816-25	136	FIELD	2186	PL16L1CR	ENAMEL	16	L	1	CR	2		4.36	.
346	CORE	ICP	4816-25	137	FIELD	2187	LF16L1CR	LATEX	16	L	1	CR	4		6.89	.
347	CORE	ICP	4816-25	138	FIELD	2188	PL16D0CR	ENAMEL	16	D	0	CR	2		4.17	.
348	CORE	ICP	4816-25	139	FIELD	2189	LF16D0CR	LATEX	16	D	0	CR	4		6.79	.
349	CORE	ICP	4816-25	140	FIELD	2190	PL16L0CR	ENAMEL	16	L	0	CR	2	<	3.73	.
350	CORE	ICP	4816-25	141	FIELD	2191	LF16L0CR	LATEX	16	L	0	CR	4		4.91	.
351	CORE	ICP	4816-25	148	FIELD	2192	PL17D2CR	ENAMEL	17	D	2	CR	2		4.85	.
352	CORE	ICP	4816-25	149	FIELD	2193	LF17D2CR	LATEX	17	D	2	CR	4		8.38	.
353	CORE	ICP	4816-25	150	FIELD	2194	PL17L2CR	ENAMEL	17	L	2	CR	2		5.61	.
354	CORE	ICP	4816-25	151	FIELD	2195	LF17L2CR	LATEX	17	L	2	CR	4		10.32	.
355	CORE	ICP	4816-25	152	FIELD	2196	PL18D2CR	ENAMEL	18	D	2	CR	2		4.84	.
356	CORE	ICP	4816-25	153	FIELD	2197	LF18D2CR	LATEX	18	D	2	CR	4		9.11	.
357	CORE	ICP	4816-25	154	FIELD	2198	PL18L2CR	ENAMEL	18	L	2	CR	2		6.28	.
358	CORE	ICP	4816-25	155	FIELD	2199	LF18L2CR	LATEX	18	L	2	CR	4		8.37	.
359	CORE	ICP	4816-25	156	FIELD	2200	PL19D2CR	ENAMEL	19	D	2	CR	2		9.30	.
360	CORE	ICP	4816-25	157	FIELD	2201	LF19D2CR	LATEX	19	D	2	CR	4		6.78	.
361	CORE	ICP	4816-25	162	FIELD	2202	PL19L2CR	ENAMEL	19	L	2	CR	2		7.05	.
362	CORE	ICP	4816-25	163	FIELD	2203	LF19L2CR	LATEX	19	L	2	CR	4		8.07	.
363	CORE	ICP	4816-25	164	MMB	2381	MMB								5.19	.
364	CORE	ICP	4816-25	165	SRM 2710	2382 DF5	SRM 2710								5271.00	95.4
365	CORE	ICP	4816-25	166	LCS	2383	LCS								89.33	89.3
366	CORE	ICP	4816-25	167	MB	2447	MB							<	3.73	

IFILE=E09087A

OBS	MATRIX	INSTRMNT	PREPBTCH	RUN_NO	QC_ID	LAB_ID	SAMPLEID	SUBSTRAT	CLMIX	SOILTYPE	SOILBTCH	SMPLTYPE	MIL	C	AMOUNT	SRMREC
367	LIQUID	ICP	4816-37	23	FIELD	2328	2PCPLL1	ENAMEL		L	1		2		783.50	.
368	LIQUID	ICP	4816-37	24	FIELD	2329	PCPLL1RR	ENAMEL		L	1	RR	2		20.09	.
369	LIQUID	ICP	4816-37	25	FIELD	2333	4PCLFL1	LATEX		L	1		4		1550.10	.
370	LIQUID	ICP	4816-37	26	FIELD	2334	PCLFL1RR	LATEX		L	1	RR	4		52.83	.
371	LIQUID	ICP	4816-37	27	FIELD	2338	4PCLFD1	LATEX		D	1		4		1931.40	.
372	LIQUID	ICP	4816-37	28	FIELD	2339	PCLFD1RR	LATEX		D	1	RR	4		61.33	.
373	LIQUID	ICP	4816-37	29	FIELD	2343	2PCPLD1	ENAMEL		D	1		2		974.70	.
374	LIQUID	ICP	4816-37	30	FIELD	2344	PCPLD1RR	ENAMEL		D	1	RR	2		33.68	.
375	LIQUID	ICP	4816-37	31	FIELD	2348 DF2	4PCLFD2	LATEX		D	2		4		2004.60	.
376	LIQUID	ICP	4816-37	32	FIELD	2349	PCLFD2RR	LATEX		D	2	RR	4		42.34	.
377	LIQUID	ICP	4816-37	38	FIELD	2353	2PCPLD2	ENAMEL		D	2		2		964.72	.
378	LIQUID	ICP	4816-37	39	FIELD	2354	PCPLD2RR	ENAMEL		D	2	RR	2		26.26	.
379	LIQUID	ICP	4816-37	40	FIELD	2358	2PCPLL2	ENAMEL		L	2		2		909.29	.
380	LIQUID	ICP	4816-37	41	FIELD	2359	PCPLL2RR	ENAMEL		L	2	RR	2		20.03	.
381	LIQUID	ICP	4816-37	42	FIELD	2363	4PCLFL2	LATEX		L	2		4		1987.00	.
382	LIQUID	ICP	4816-37	43	FIELD	2364	PCLFL2RR	LATEX		L	2	RR	4		70.21	.
383	LIQUID	ICP	4816-37	44	SRM 2710	2454 DF5	SRM 2710								5055.50	90.7304
384	LIQUID	ICP	4816-37	45	LCS	2455	LCS								86.62	86.6190
385	LIQUID	ICP	4816-37	46	MMB	2456	MMB							<	2.38	.
386	LIQUID	ICP	4816-37	47	MB	2457	MB							<	2.38	.
387	CORE	ICP	4816-26	55	FIELD	2204	PL20D2CR	ENAMEL	20	D	2	CR	2	<	2.38	.
388	CORE	ICP	4816-26	56	FIELD	2205	LF20D2CR	LATEX	20	D	2	CR	4		4.46	.
389	CORE	ICP	4816-26	57	FIELD	2206	PL20L2CR	ENAMEL	20	L	2	CR	2	<	2.38	.
390	CORE	ICP	4816-26	58	FIELD	2207	LF20L2CR	LATEX	20	L	2	CR	4		7.45	.
391	CORE	ICP	4816-26	59	FIELD	2208	PL21D2CR	ENAMEL	21	D	2	CR	2		18.26	.
392	CORE	ICP	4816-26	60	FIELD	2209	LF21D2CR	LATEX	21	D	2	CR	4		2.80	.
393	CORE	ICP	4816-26	61	FIELD	2210	PL21L2CR	ENAMEL	21	L	2	CR	2		2.75	.
394	CORE	ICP	4816-26	62	FIELD	2211	LF21L2CR	LATEX	21	L	2	CR	4		4.68	.
395	CORE	ICP	4816-26	63	FIELD	2212	PL22D2CR	ENAMEL	22	D	2	CR	2	<	2.38	.
396	CORE	ICP	4816-26	64	FIELD	2213	LF22D2CR	LATEX	22	D	2	CR	4		3.89	.
397	CORE	ICP	4816-26	70	FIELD	2214	PL22L2CR	ENAMEL	22	L	2	CR	2	<	2.38	.
398	CORE	ICP	4816-26	71	FIELD	2215	LF22L2CR	LATEX	22	L	2	CR	4		3.41	.
399	CORE	ICP	4816-26	72	FIELD	2216	PL23D2CR	ENAMEL	23	D	2	CR	2		2.78	.
400	CORE	ICP	4816-26	73	FIELD	2217	LF23D2CR	LATEX	23	D	2	CR	4		5.72	.
401	CORE	ICP	4816-26	74	FIELD	2218	PL23L2CR	ENAMEL	23	L	2	CR	2		6.83	.
402	CORE	ICP	4816-26	75	FIELD	2219	LF23L2CR	LATEX	23	L	2	CR	4		5.60	.
403	CORE	ICP	4816-26	76	FIELD	2220	PL24D2CR	ENAMEL	24	D	2	CR	2	<	2.38	.
404	CORE	ICP	4816-26	77	FIELD	2221	LF24D2CR	LATEX	24	D	2	CR	4		3.29	.
405	CORE	ICP	4816-26	78	FIELD	2222	PL24L2CR	ENAMEL	24	L	2	CR	2		4.48	.
406	CORE	ICP	4816-26	79	FIELD	2223	LF24L2CR	LATEX	24	L	2	CR	4		3.68	.
407	CORE	ICP	4816-26	85	LCS	2391	LCS								89.34	89.3400
408	CORE	ICP	4816-26	86	SRM 2710	2392 DF5	SRM 2710								4972.60	89.8068
409	CORE	ICP	4816-26	87	MMB	2395	MMB							<	2.38	.
410	CORE	ICP	4816-26	88	MB	2448	MB								2.58	.
411	CORE	ICP	4816-30	89	FIELD	2224	PL25D2CR	ENAMEL	25	D	2	CR	2	<	2.38	.
412	CORE	ICP	4816-30	90	FIELD	2225	LF25D2CR	LATEX	25	D	2	CR	4		5.15	.
413	CORE	ICP	4816-30	91	FIELD	2226	PL25L2CR	ENAMEL	25	L	2	CR	2		2.88	.
414	CORE	ICP	4816-30	92	FIELD	2227	LF25L2CR	LATEX	25	L	2	CR	4		5.51	.
415	CORE	ICP	4816-30	93	FIELD	2228	PL26D2CR	ENAMEL	26	D	2	CR	2		2.59	.
416	CORE	ICP	4816-30	94	FIELD	2229	LF26D2CR	LATEX	26	D	2	CR	4		7.21	.
417	CORE	ICP	4816-30	102	FIELD	2230	PL26L2CR	ENAMEL	26	L	2	CR	2		3.15	.
418	CORE	ICP	4816-30	103	FIELD	2231	LF26L2CR	LATEX	26	L	2	CR	4		4.69	.
419	CORE	ICP	4816-30	104	FIELD	2232	PL27D2CR	ENAMEL	27	D	2	CR	2	<	2.38	.

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(continued)

OBS	MATRIX	INSTRMNT	PREPBTCH	RUN_NO	QC_ID	LAB_ID	SAMPLEID	SUBSTRAT	CLMIX	SOILTYPE	SOILBTCH	SMPLTYPE	MIL	C	AMOUNT	SRMREC
420	CORE	ICP	4816-30	105	FIELD	2233	LF27D2CR	LATEX	27	D	2	CR	4		3.23	.
421	CORE	ICP	4816-30	106	FIELD	2234	PL27L2CR	ENAMEL	27	L	2	CR	2		4.34	.
422	CORE	ICP	4816-30	107	FIELD	2235	LF27L2CR	LATEX	27	L	2	CR	4		5.83	.
423	CORE	ICP	4816-30	108	FIELD	2236	PL28D2CR	ENAMEL	28	D	2	CR	2		5.63	.
424	CORE	ICP	4816-30	109	FIELD	2237	LF28D2CR	LATEX	28	D	2	CR	4		3.88	.
425	CORE	ICP	4816-30	110	FIELD	2238	PL28L2CR	ENAMEL	28	L	2	CR	2		3.83	.
426	CORE	ICP	4816-30	111	FIELD	2239	LF28L2CR	LATEX	28	L	2	CR	4		5.27	.
427	CORE	ICP	4816-30	117	FIELD	2240	PL29D2CR	ENAMEL	29	D	2	CR	2		2.84	.
428	CORE	ICP	4816-30	118	FIELD	2241	LF29D2CR	LATEX	29	D	2	CR	4		8.11	.
429	CORE	ICP	4816-30	119	FIELD	2242	PL29L2CR	ENAMEL	29	L	2	CR	2		5.49	.
430	CORE	ICP	4816-30	120	FIELD	2243	LF29L2CR	LATEX	29	L	2	CR	4		6.39	.
431	CORE	ICP	4816-30	121	SRM 2710	2380 DF5	SRM 2710								5247.50	94.3795
432	CORE	ICP	4816-30	122	LCS	2397	LCS								74.30	74.3010
433	CORE	ICP	4816-30	123	MMB	2425	MMB								9.21	.
434	CORE	ICP	4816-30	124	MB	2450	MB							<	2.38	.
435	CORE	ICP	4816-31	125	FIELD	2244	PL30D2CR	ENAMEL	30	D	2	CR	2		3.09	.
436	CORE	ICP	4816-31	126	FIELD	2245	LF30D2CR	LATEX	30	D	2	CR	4		5.39	.
437	CORE	ICP	4816-31	134	FIELD	2246	PL30L2CR	ENAMEL	30	L	2	CR	2		3.62	.
438	CORE	ICP	4816-31	135	FIELD	2247	LF30L2CR	LATEX	30	L	2	CR	4		4.36	.
439	CORE	ICP	4816-31	136	FIELD	2248	PL31D2CR	ENAMEL	31	D	2	CR	2		2.47	.
440	CORE	ICP	4816-31	137	FIELD	2249	LF31D2CR	LATEX	31	D	2	CR	4		6.77	.
441	CORE	ICP	4816-31	138	FIELD	2250	PL31L2CR	ENAMEL	31	L	2	CR	2		3.19	.
442	CORE	ICP	4816-31	139	FIELD	2251	LF31L2CR	LATEX	31	L	2	CR	4		7.62	.
443	CORE	ICP	4816-31	140	FIELD	2252	PL32D2CR	ENAMEL	32	D	2	CR	2		3.14	.
444	CORE	ICP	4816-31	141	FIELD	2253	LF32D2CR	LATEX	32	D	2	CR	4		5.00	.
445	CORE	ICP	4816-31	142	FIELD	2254	PL32L2CR	ENAMEL	32	L	2	CR	2		4.79	.
446	CORE	ICP	4816-31	143	FIELD	2255	LF32L2CR	LATEX	32	L	2	CR	4		3.84	.
447	CORE	ICP	4816-31	148	FIELD	2256	PL32D0CR	ENAMEL	32	D	0	CR	2		4.70	.
448	CORE	ICP	4816-31	149	FIELD	2257	LF32D0CR	LATEX	32	D	0	CR	4		3.36	.
449	CORE	ICP	4816-31	150	FIELD	2258	PL32L0CR	ENAMEL	32	L	0	CR	2		2.97	.
450	CORE	ICP	4816-31	151	FIELD	2259	LF32L0CR	LATEX	32	L	0	CR	4		3.17	.
451	CORE	ICP	4816-31	152	FIELD	2332	PCPLL1CR	ENAMEL		L	1	CR	2		4.30	.
452	CORE	ICP	4816-31	153	FIELD	2337	PCLFL1CR	LATEX		L	1	CR	4		4.69	.
453	CORE	ICP	4816-31	154	FIELD	2342	PCLFD1CR	LATEX		D	1	CR	4		7.21	.
454	CORE	ICP	4816-31	155	FIELD	2347	PCPLD1CR	ENAMEL		D	1	CR	2		8.70	.
455	CORE	ICP	4816-31	156	SRM 2710	2378 DF5	SRM 2710								5170.50	92.6115
456	CORE	ICP	4816-31	157	LCS	2390	LCS								76.39	76.3900
457	CORE	ICP	4816-31	162	MMB	2423	MMB								9.67	.
458	CORE	ICP	4816-31	163	MB	2451	MB								3.71	.
459	CORE	ICP	4816-32	164	FIELD	2352	PCLFD2CR	LATEX		D	2	CR	4		5.29	.
460	CORE	ICP	4816-32	165	FIELD	2357	PCPLD2CR	ENAMEL		D	2	CR	2		4.50	.
461	CORE	ICP	4816-32	166	FIELD	2362	PCPLL2CR	ENAMEL		L	2	CR	2		5.43	.
462	CORE	ICP	4816-32	167	FIELD	2367	PCLFL2CR	LATEX		L	2	CR	4		4.18	.
463	CORE	ICP	4816-32	168	LCS	2377	LCS								81.27	81.2720
464	CORE	ICP	4816-32	169	MMB	2422	MMB								6.40	.
465	CORE	ICP	4816-32	170	SRM 2710	2427 DF5	SRM 2710								5113.50	92.4015
466	CORE	ICP	4816-32	171	MB	2452	MB							<	2.38	.

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OBS	MATRIX	INSTRMNT	PREPBTCH	RUN_NO	QC_ID	LAB_ID	SAMPLEID	SUBSTRAT	CLMIX	SOILTYPE	SOILBTCH	SMPLTYPE	MIL	C	AMOUNT	SRMREC
467	CORE	GFAA	4816-21	12	FIELD	2164	PL11D1CR	ENAMEL	11	D	1	CR	2		2.90	.
468	CORE	GFAA	4816-21	13	FIELD	2165	LF11D1CR	LATEX	11	D	1	CR	4		4.65	.
469	CORE	GFAA	4816-21	14	FIELD	2166	PL11L1CR	ENAMEL	11	L	1	CR	2		3.02	.
470	CORE	GFAA	4816-21	15	FIELD	2167	LF11L1CR	LATEX	11	L	1	CR	4		3.07	.
471	CORE	GFAA	4816-21	16	FIELD	2168	PL12D1CR	ENAMEL	12	D	1	CR	2		3.90	.
472	CORE	GFAA	4816-21	17	FIELD	2169	LF12D1CR	LATEX	12	D	1	CR	4		3.26	.
473	CORE	GFAA	4816-21	19	FIELD	2170	PL12L1CR	ENAMEL	12	L	1	CR	2		2.89	.
474	CORE	GFAA	4816-21	22	FIELD	2171	LF12L1CR	LATEX	12	L	1	CR	4		4.91	.
475	CORE	GFAA	4816-21	23	FIELD	2172	PL13D1CR	ENAMEL	13	D	1	CR	2		2.32	.
476	CORE	GFAA	4816-21	24	FIELD	2173	LF13D1CR	LATEX	13	D	1	CR	4		4.79	.
477	CORE	GFAA	4816-21	25	FIELD	2174	PL13L1CR	ENAMEL	13	L	1	CR	2		2.40	.
478	CORE	GFAA	4816-21	26	FIELD	2175	LF13L1CR	LATEX	13	L	1	CR	4		6.15	.
479	CORE	GFAA	4816-21	28	FIELD	2176	PL14D1CR	ENAMEL	14	D	1	CR	2		3.33	.
480	CORE	GFAA	4816-21	29	FIELD	2177	LF14D1CR	LATEX	14	D	1	CR	4		3.79	.
481	CORE	GFAA	4816-21	30	FIELD	2178	PL14L1CR	ENAMEL	14	L	1	CR	2		3.08	.
482	CORE	GFAA	4816-21	31	FIELD	2179	LF14L1CR	LATEX	14	L	1	CR	4		5.08	.
483	CORE	GFAA	4816-21	34	FIELD	2180	PL15D1CR	ENAMEL	15	D	1	CR	2		1.88	.
484	CORE	GFAA	4816-21	35	FIELD	2181	LF15D1CR	LATEX	15	D	1	CR	4		4.94	.
485	CORE	GFAA	4816-21	37	FIELD	2182	PL15L1CR	ENAMEL	15	L	1	CR	2		1.92	.
486	CORE	GFAA	4816-21	38	FIELD	2183	LF15L1CR	LATEX	15	L	1	CR	4		5.61	.
487	CORE	GFAA	4816-21	39	LCS	2396	LCS								80.50	80.5
488	CORE	GFAA	4816-21	40	MMB	2426	MMB								2.38	.
489	CORE	GFAA	4816-21	41	MB	2444	MB							<	0.06	.
490	CORE	GFAA	4816-25	42	FIELD	2184	PL16D1CR	ENAMEL	16	D	1	CR	2		1.16	.

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OBS	MATRIX	INSTRMNT	PREPBTCH	RUN_NO	QC_ID	LAB_ID	SAMPLEID	SUBSTRAT	CLMIX	SOILTYPE	SOILBTCH	SMPLTYPE	MIL C	AMOUNT	SRMREC
491	CORE	GFAA	4816-18	12	FIELD	2124	PL01D1CR	ENAMEL	01	D	1	CR	2	2.66	.
492	CORE	GFAA	4816-18	13	FIELD	2125	LF01D1CR	LATEX	01	D	1	CR	4	4.41	.
493	CORE	GFAA	4816-18	14	FIELD	2126	PL01L1CR	ENAMEL	01	L	1	CR	2	4.60	.
494	CORE	GFAA	4816-18	15	FIELD	2127	LF01L1CR	LATEX	01	L	1	CR	4	5.45	.
495	CORE	GFAA	4816-18	16	FIELD	2128	PL02D1CR	ENAMEL	02	D	1	CR	2	2.39	.
496	CORE	GFAA	4816-18	17	FIELD	2129	LF02D1CR	LATEX	02	D	1	CR	4	3.05	.
497	CORE	GFAA	4816-18	19	FIELD	2130	PL02L1CR	ENAMEL	02	L	1	CR	2	3.19	.
498	CORE	GFAA	4816-18	20	FIELD	2131	LF02L1CR	LATEX	02	L	1	CR	4	3.44	.
499	CORE	GFAA	4816-18	23	FIELD	2132	PL03D1CR	ENAMEL	03	D	1	CR	2	2.83	.
500	CORE	GFAA	4816-18	24	FIELD	2133	LF03D1CR	LATEX	03	D	1	CR	4	5.18	.
501	CORE	GFAA	4816-18	25	FIELD	2134	PL03L1CR	ENAMEL	03	L	1	CR	2	2.89	.
502	CORE	GFAA	4816-18	26	FIELD	2135	LF03L1CR	LATEX	03	L	1	CR	4	3.86	.
503	CORE	GFAA	4816-18	28	FIELD	2136	PL04D1CR	ENAMEL	04	D	1	CR	2	2.74	.
504	CORE	GFAA	4816-18	29	FIELD	2137	LF04D1CR	LATEX	04	D	1	CR	4	4.18	.
505	CORE	GFAA	4816-18	30	FIELD	2138	PL04L1CR	ENAMEL	04	L	1	CR	2	3.65	.
506	CORE	GFAA	4816-18	31	FIELD	2139	LF04L1CR	LATEX	04	L	1	CR	4	2.37	.
507	CORE	GFAA	4816-18	32	FIELD	2140	PL05D1CR	ENAMEL	05	D	1	CR	2	1.70	.
508	CORE	GFAA	4816-18	35	FIELD	2141	LF05D1CR	LATEX	05	D	1	CR	4	4.91	.
509	CORE	GFAA	4816-18	37	FIELD	2142	PL05L1CR	ENAMEL	05	L	1	CR	2	3.11	.
510	CORE	GFAA	4816-18	38	FIELD	2143	LF05L1CR	LATEX	05	L	1	CR	4	3.11	.
511	CORE	GFAA	4816-18	39	LCS	2379	LCS							96.00	96
512	CORE	GFAA	4816-18	40	MMB	2424	MMB							2.37	.
513	CORE	GFAA	4816-18	41	MB	2442	MB							0.34	.
514	CORE	GFAA	4816-20	42	FIELD	2144	PL06D1CR	ENAMEL	06	D	1	CR	2	1.67	.
515	CORE	GFAA	4816-20	44	FIELD	2145	LF06D1CR	LATEX	06	D	1	CR	4	7.64	.
516	CORE	GFAA	4816-20	47	FIELD	2146	PL06L1CR	ENAMEL	06	L	1	CR	2	7.54	.
517	CORE	GFAA	4816-20	48	FIELD	2147	LF06L1CR	LATEX	06	L	1	CR	4	3.53	.
518	CORE	GFAA	4816-20	49	FIELD	2148	PL07D1CR	ENAMEL	07	D	1	CR	2	5.17	.
519	CORE	GFAA	4816-20	50	FIELD	2149	LF07D1CR	LATEX	07	D	1	CR	4	4.35	.
520	CORE	GFAA	4816-20	51	FIELD	2150	PL07L1CR	ENAMEL	07	L	1	CR	2	2.82	.
521	CORE	GFAA	4816-20	53	FIELD	2151	LF07L1CR	LATEX	07	L	1	CR	4	3.15	.
522	CORE	GFAA	4816-20	54	FIELD	2152	PL08D1CR	ENAMEL	08	D	1	CR	2	3.83	.
523	CORE	GFAA	4816-20	55	FIELD	2153	LF08D1CR	LATEX	08	D	1	CR	4	6.40	.
524	CORE	GFAA	4816-20	56	FIELD	2154	PL08L1CR	ENAMEL	08	L	1	CR	2	3.02	.
525	CORE	GFAA	4816-20	59	FIELD	2155	LF08L1CR	LATEX	08	L	1	CR	4	6.01	.
526	CORE	GFAA	4816-20	60	FIELD	2156	PL09D1CR	ENAMEL	09	D	1	CR	2	2.76	.
527	CORE	GFAA	4816-20	64	FIELD	2157	LF09D1CR	LATEX	09	D	1	CR	4	12.07	.
528	CORE	GFAA	4816-20	65	FIELD	2158	PL09L1CR	ENAMEL	09	L	1	CR	2	3.33	.
529	CORE	GFAA	4816-20	66	FIELD	2159	LF09L1CR	LATEX	09	L	1	CR	4	6.15	.
530	CORE	GFAA	4816-20	67	FIELD	2160	PL10D1CR	ENAMEL	10	D	1	CR	2	3.46	.
531	CORE	GFAA	4816-20	68	FIELD	2161	LF10D1CR	LATEX	10	D	1	CR	4	5.02	.
532	CORE	GFAA	4816-20	69	FIELD	2162	PL10L1CR	ENAMEL	10	L	1	CR	2	7.44	.
533	CORE	GFAA	4816-20	70	FIELD	2163	LF10L1CR	LATEX	10	L	1	CR	4	7.56	.
534	CORE	GFAA	4816-20	71	MMB	2393	MMB							2.76	.
535	CORE	GFAA	4816-20	72	LCS	2428	LCS							86.00	86
536	CORE	GFAA	4816-20	75	MB	2443	MB							0.89	.

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OBS	MATRIX	INSTRMNT	PREPBTCH	RUN_NO	QC_ID	LAB_ID	SAMPLEID	SUBSTRAT	CLMIX	SOILTYPE	SOILBTCH	SMPLTYPE	MIL	C	AMOUNT	SRMREC
537	CORE	GFAA	4816-25	12	FIELD	2185	LF16D1CR	LATEX	16	D	1	CR	4		3.82	.
538	CORE	GFAA	4816-25	13	FIELD	2186	PL16L1CR	ENAMEL	16	L	1	CR	2		2.57	.
539	CORE	GFAA	4816-25	14	FIELD	2187	LF16L1CR	LATEX	16	L	1	CR	4		4.67	.
540	CORE	GFAA	4816-25	16	FIELD	2188	PL16D0CR	ENAMEL	16	D	0	CR	2		1.47	.
541	CORE	GFAA	4816-25	17	FIELD	2189	LF16D0CR	LATEX	16	D	0	CR	4		2.43	.
542	CORE	GFAA	4816-25	18	FIELD	2190	PL16L0CR	ENAMEL	16	L	0	CR	2		2.62	.
543	CORE	GFAA	4816-25	20	FIELD	2191	LF16L0CR	LATEX	16	L	0	CR	4		1.88	.
544	CORE	GFAA	4816-25	23	FIELD	2192	PL17D2CR	ENAMEL	17	D	2	CR	2		2.62	.
545	CORE	GFAA	4816-25	24	FIELD	2193	LF17D2CR	LATEX	17	D	2	CR	4		4.89	.
546	CORE	GFAA	4816-25	26	FIELD	2194	PL17L2CR	ENAMEL	17	L	2	CR	2		2.86	.
547	CORE	GFAA	4816-25	27	FIELD	2195	LF17L2CR	LATEX	17	L	2	CR	4		9.20	.
548	CORE	GFAA	4816-25	28	FIELD	2196	PL18D2CR	ENAMEL	18	D	2	CR	2		1.74	.
549	CORE	GFAA	4816-25	30	FIELD	2197	LF18D2CR	LATEX	18	D	2	CR	4		6.32	.
550	CORE	GFAA	4816-25	31	FIELD	2198	PL18L2CR	ENAMEL	18	L	2	CR	2		2.02	.
551	CORE	GFAA	4816-25	34	FIELD	2199	LF18L2CR	LATEX	18	L	2	CR	4		5.87	.
552	CORE	GFAA	4816-25	36	FIELD	2200	PL19D2CR	ENAMEL	19	D	2	CR	2		6.22	.
553	CORE	GFAA	4816-25	37	FIELD	2201	LF19D2CR	LATEX	19	D	2	CR	4		4.27	.
554	CORE	GFAA	4816-25	38	FIELD	2202	PL19L2CR	ENAMEL	19	L	2	CR	2		2.56	.
555	CORE	GFAA	4816-25	40	FIELD	2203	LF19L2CR	LATEX	19	L	2	CR	4		5.14	.
556	CORE	GFAA	4816-25	41	MMB	2381	MMB								1.44	.
557	CORE	GFAA	4816-25	42	LCS	2383	LCS								95.50	95.5
558	CORE	GFAA	4816-25	43	MB	2447	MB								0.32	.

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OBS	MATRIX	INSTRMNT	PREPBTCH	RUN_NO	QC_ID	LAB_ID	SAMPLEID	SUBSTRAT	CLMIX	SOILTYPE	SOILBTCH	SMPLTYPE	MIL	C	AMOUNT	SRMREC
559	SPONGE	GFAA	4816-23	12	FIELD	2053	LF16DOSP	LATEX	16	D	0	SP	4		2.70	.
560	SPONGE	GFAA	4816-23	13	FIELD	2054	PL16LOSP	ENAMEL	16	L	0	SP	2		3.23	.
561	SPONGE	GFAA	4816-23	14	FIELD	2055	LF16LOSP	LATEX	16	L	0	SP	4		15.39	.
562	SPONGE	GFAA	4816-23	16	MMB	2408	MMB								25.10	.
563	SPONGE	GFAA	4816-23	17	LCS	2416	LCS								107.75	107.750
564	SPONGE	GFAA	4816-23	20	MB	2445	MB								0.50	.
565	SPONGE	GFAA	4816-34	22	FIELD	2120	PL32DOSP	ENAMEL	32	D	0	SP	2		1.62	.
566	SPONGE	GFAA	4816-34	23	FIELD	2121	LF32DOSP	LATEX	32	D	0	SP	4		4.73	.
567	SPONGE	GFAA	4816-34	24	FIELD	2122	PL32LOSP	ENAMEL	32	L	0	SP	2		12.44	.
568	SPONGE	GFAA	4816-34	26	MMB	2410	MMB								2.20	.
569	SPONGE	GFAA	4816-34	27	SRM 2710	2411	SRM 2710								4520.00	81.047
570	SPONGE	GFAA	4816-34	28	SRM 2710	2414	SRM 2710								4700.00	84.517
571	SPONGE	GFAA	4816-34	32	MB	2453	MB							<	0.19	.

IFILE=V09097A.F1

OBS	MATRIX	INSTRMNT	PREPBTCH	RUN_NO	QC_ID	LAB_ID	SAMPLEID	SUBSTRAT	CLMIX	SOILTYPE	SOILBTCH	SMPLTYPE	MIL	C	AMOUNT	SRMREC
572	WIPE	GFAA	4816-13	12	FIELD	2310	PL27D2WW	ENAMEL	27	D	2	WW	2		17.43	.
573	WIPE	GFAA	4816-13	13	FIELD	2312	PL27L2WW	ENAMEL	27	L	2	WW	2		29.87	.
574	WIPE	GFAA	4816-13	14	FIELD	2314	PL28D2WW	ENAMEL	28	D	2	WW	2		2.03	.
575	WIPE	GFAA	4816-13	17	FIELD	2315	LF28D2WW	LATEX	28	D	2	WW	4		19.86	.
576	WIPE	GFAA	4816-13	18	FIELD	2316	PL28L2WW	ENAMEL	28	L	2	WW	2		12.02	.
577	WIPE	GFAA	4816-13	20	FIELD	2317	LF28L2WW	LATEX	28	L	2	WW	4		42.06	.
578	WIPE	GFAA	4816-13	21	FIELD	2318	PL30D2WW	ENAMEL	30	D	2	WW	2		4.22	.
579	WIPE	GFAA	4816-13	24	FIELD	2319	LF30D2WW	LATEX	30	D	2	WW	4		25.69	.
580	WIPE	GFAA	4816-13	25	FIELD	2320	PL30L2WW	ENAMEL	30	L	2	WW	2		14.81	.
581	WIPE	GFAA	4816-13	26	FIELD	2321	LF30L2WW	LATEX	30	L	2	WW	4		25.70	.
582	WIPE	GFAA	4816-13	28	FIELD	2322	PL32D2WW	ENAMEL	32	D	2	WW	2		2.05	.
583	WIPE	GFAA	4816-13	31	FIELD	2323	LF32D2WW	LATEX	32	D	2	WW	4		19.61	.
584	WIPE	GFAA	4816-13	32	FIELD	2324	PL32L2WW	ENAMEL	32	L	2	WW	2		3.52	.
585	WIPE	GFAA	4816-13	33	FIELD	2325	LF32L2WW	LATEX	32	L	2	WW	4		19.32	.
586	WIPE	GFAA	4816-13	37	LCS	2435	LCS								87.25	87.25
587	WIPE	GFAA	4816-13	38	MB	2436	MB							<	0.19	.
588	WIPE	GFAA	4816-8A	39	FIELD	2260	PL01D1WW	ENAMEL	01	D	1	WW	2		12.84	.
589	WIPE	GFAA	4816-8A	40	FIELD	2261	LF01D1WW	LATEX	01	D	1	WW	4		39.49	.
590	WIPE	GFAA	4816-8A	43	FIELD	2262	PL01L1WW	ENAMEL	01	L	1	WW	2		30.42	.
591	WIPE	GFAA	4816-8A	47	FIELD	2264	PL03D1WW	ENAMEL	03	D	1	WW	2		13.85	.
592	WIPE	GFAA	4816-8A	48	FIELD	2266	PL03L1WW	ENAMEL	03	L	1	WW	2		39.46	.
593	WIPE	GFAA	4816-8A	49	FIELD	2268	PL05D1WW	ENAMEL	05	D	1	WW	2		7.14	.
594	WIPE	GFAA	4816-8A	52	FIELD	2270	PL05L1WW	ENAMEL	05	L	1	WW	2		23.53	.
595	WIPE	GFAA	4816-8A	53	FIELD	2272	PL06D1WW	ENAMEL	06	D	1	WW	2		6.09	.
596	WIPE	GFAA	4816-8A	55	FIELD	2274	PL06L1WW	ENAMEL	06	L	1	WW	2		15.83	.
597	WIPE	GFAA	4816-8A	56	FIELD	2276	PL11D1WW	ENAMEL	11	D	1	WW	2		2.39	.
598	WIPE	GFAA	4816-8A	57	FIELD	2277	LF11D1WW	LATEX	11	D	1	WW	4		45.65	.
599	WIPE	GFAA	4816-8A	69	FIELD	2278	PL11L1WW	ENAMEL	11	L	1	WW	2		7.73	.
600	WIPE	GFAA	4816-8A	70	FIELD	2279	LF11L1WW	LATEX	11	L	1	WW	4		31.69	.
601	WIPE	GFAA	4816-8A	72	LCS	2384	LCS								99.75	99.75
602	WIPE	GFAA	4816-8A	73	MMB	2385	MMB								0.37	.
603	WIPE	GFAA	4816-8A	74	MB	2420	MB							<	0.19	.
604	WIPE	GFAA	4816-13	75	MMB	2389	MMB								2.12	.

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OBS	MATRIX	INSTRMNT	PREPBTCH	RUN_NO	QC_ID	LAB_ID	SAMPLEID	SUBSTRAT	CLMIX	SOILTYPE	SOILBTCH	SMPLTYPE	MIL	C	AMOUNT	SRMREC
605	WIPE	GFAA	4816-8B	12	FIELD	2280	PL12D1WW	ENAMEL	12	D	1	WW	2		5.31	.
606	WIPE	GFAA	4816-8B	13	FIELD	2282	PL12L1WW	ENAMEL	12	L	1	WW	2		12.61	.
607	WIPE	GFAA	4816-8B	14	FIELD	2283	LF12L1WW	LATEX	12	L	1	WW	4		21.69	.
608	WIPE	GFAA	4816-8B	15	FIELD	2284	PL14D1WW	ENAMEL	14	D	1	WW	2		3.64	.
609	WIPE	GFAA	4816-8B	18	FIELD	2285	LF14D1WW	LATEX	14	D	1	WW	4		20.38	.
610	WIPE	GFAA	4816-8B	19	FIELD	2286	PL14L1WW	ENAMEL	14	L	1	WW	2		7.99	.
611	WIPE	GFAA	4816-8B	21	FIELD	2288	PL16D1WW	ENAMEL	16	D	1	WW	2		14.02	.
612	WIPE	GFAA	4816-8B	22	FIELD	2289	LF16D1WW	LATEX	16	D	1	WW	4		20.99	.
613	WIPE	GFAA	4816-8B	23	FIELD	2290	PL16L1WW	ENAMEL	16	L	1	WW	2		13.48	.
614	WIPE	GFAA	4816-8B	26	FIELD	2292	PL16D0WW	ENAMEL	16	D	0	WW	2		2.45	.
615	WIPE	GFAA	4816-8B	27	FIELD	2293	LF16D0WW	LATEX	16	D	0	WW	4		0.41	.
616	WIPE	GFAA	4816-8B	28	FIELD	2294	PL19D2WW	ENAMEL	19	D	2	WW	2		5.66	.
617	WIPE	GFAA	4816-8B	30	FIELD	2296	PL19L2WW	ENAMEL	19	L	2	WW	2		7.02	.
618	WIPE	GFAA	4816-8B	31	FIELD	2326	PL32L0WW	ENAMEL	32	L	0	WW	2		0.55	.
619	WIPE	GFAA	4816-8B	32	FIELD	2327	LF32L0WW	LATEX	32	L	0	WW	4		0.39	.
620	WIPE	GFAA	4816-8B	33	LCS	2386	LCS								86.50	86.50
621	WIPE	GFAA	4816-8B	34	MMB	2387	MMB								0.34	.
622	WIPE	GFAA	4816-8B	35	MB	2421	MB								0.24	.
623	WIPE	GFAA	4816-17	39	FIELD	2331	PCPLL1W2	ENAMEL		L	1	W2	2		14.43	.
624	WIPE	GFAA	4816-17	40	FIELD	2346	PCPLD1W2	ENAMEL		D	1	W2	2		21.12	.
625	WIPE	GFAA	4816-17	41	FIELD	2361	PCPLL2W2	ENAMEL		L	2	W2	2		34.47	.
626	WIPE	GFAA	4816-17	44	MMB	2439	MMB								2.47	.
627	WIPE	GFAA	4816-17	45	MB	2440	MB								26.81	.
628	WIPE	GFAA	4816-17	46	LCS	2441	LCS								0.21	0.21
629	WIPE	GFAA	4816-12	48	FIELD	2298	PL21D2WW	ENAMEL	21	D	2	WW	2		14.09	.
630	WIPE	GFAA	4816-12	51	FIELD	2299	LF21D2WW	LATEX	21	D	2	WW	4		27.77	.
631	WIPE	GFAA	4816-12	52	FIELD	2300	PL21L2WW	ENAMEL	21	L	2	WW	2		27.56	.
632	WIPE	GFAA	4816-12	53	FIELD	2302	PL22D2WW	ENAMEL	22	D	2	WW	2		4.07	.
633	WIPE	GFAA	4816-12	54	FIELD	2304	PL22L2WW	ENAMEL	22	L	2	WW	2		9.63	.
634	WIPE	GFAA	4816-12	57	FIELD	2305	LF22L2WW	LATEX	22	L	2	WW	4		23.85	.
635	WIPE	GFAA	4816-12	59	FIELD	2306	PL26D2WW	ENAMEL	26	D	2	WW	2		3.14	.
636	WIPE	GFAA	4816-12	60	FIELD	2307	LF26D2WW	LATEX	26	D	2	WW	4		25.80	.
637	WIPE	GFAA	4816-12	61	FIELD	2308	PL26L2WW	ENAMEL	26	L	2	WW	2		9.25	.
638	WIPE	GFAA	4816-12	64	FIELD	2398	LF12D1WW2	LATEX	12	D	1	WW2	4		21.81	.
639	WIPE	GFAA	4816-12	65	FIELD	2399	LF12L1WW2	LATEX	12	L	1	WW2	4		15.25	.
640	WIPE	GFAA	4816-12	66	LCS	2388	LCS								97.00	97.00
641	WIPE	GFAA	4816-12	68	MMB	2433	MMB								1.02	.
642	WIPE	GFAA	4816-12	69	MB	2434	MB								0.58	.

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OBS	MATRIX	INSTRMNT	PREPBTCH	RUN_NO	QC_ID	LAB_ID	SAMPLEID	SUBSTRAT	CLMIX	SOILTYPE	SOILBTCH	SMPLTYPE	MIL C	AMOUNT	SRMREC
643	CORE	GFAA	4816-26	12	FIELD	2204	PL20D2CR	ENAMEL	20	D	2	CR	2	1.62	.
644	CORE	GFAA	4816-26	13	FIELD	2205	LF20D2CR	LATEX	20	D	2	CR	4	4.23	.
645	CORE	GFAA	4816-26	14	FIELD	2206	PL20L2CR	ENAMEL	20	L	2	CR	2	4.62	.
646	CORE	GFAA	4816-26	15	FIELD	2207	LF20L2CR	LATEX	20	L	2	CR	4	2.41	.
647	CORE	GFAA	4816-26	16	FIELD	2208	PL21D2CR	ENAMEL	21	D	2	CR	2	11.92	.
648	CORE	GFAA	4816-26	29	FIELD	2209	LF21D2CR	LATEX	21	D	2	CR	4	3.73	.
649	CORE	GFAA	4816-26	31	FIELD	2210	PL21L2CR	ENAMEL	21	L	2	CR	2	2.69	.
650	CORE	GFAA	4816-26	32	FIELD	2211	LF21L2CR	LATEX	21	L	2	CR	4	5.66	.
651	CORE	GFAA	4816-26	33	FIELD	2212	PL22D2CR	ENAMEL	22	D	2	CR	2	2.14	.
652	CORE	GFAA	4816-26	34	FIELD	2213	LF22D2CR	LATEX	22	D	2	CR	4	2.88	.
653	CORE	GFAA	4816-26	35	FIELD	2214	PL22L2CR	ENAMEL	22	L	2	CR	2	2.66	.
654	CORE	GFAA	4816-26	36	FIELD	2215	LF22L2CR	LATEX	22	L	2	CR	4	3.27	.
655	CORE	GFAA	4816-26	40	FIELD	2216	PL23D2CR	ENAMEL	23	D	2	CR	2	2.80	.
656	CORE	GFAA	4816-26	41	FIELD	2217	LF23D2CR	LATEX	23	D	2	CR	4	3.90	.
657	CORE	GFAA	4816-26	42	FIELD	2218	PL23L2CR	ENAMEL	23	L	2	CR	2	10.38	.
658	CORE	GFAA	4816-26	43	FIELD	2219	LF23L2CR	LATEX	23	L	2	CR	4	6.88	.
659	CORE	GFAA	4816-26	44	FIELD	2220	PL24D2CR	ENAMEL	24	D	2	CR	2	1.93	.
660	CORE	GFAA	4816-26	45	FIELD	2221	LF24D2CR	LATEX	24	D	2	CR	4	3.52	.
661	CORE	GFAA	4816-26	49	FIELD	2222	PL24L2CR	ENAMEL	24	L	2	CR	2	5.81	.
662	CORE	GFAA	4816-26	50	FIELD	2223	LF24L2CR	LATEX	24	L	2	CR	4	3.97	.
663	CORE	GFAA	4816-26	51	LCS	2391	LCS							99.00	99.00
664	CORE	GFAA	4816-26	52	MMB	2395	MMB							2.90	.
665	CORE	GFAA	4816-26	53	MB	2448	MB							2.08	.
666	CORE	GFAA	4816-30	56	FIELD	2224	PL25D2CR	ENAMEL	25	D	2	CR	2	2.79	.
667	CORE	GFAA	4816-30	58	FIELD	2225	LF25D2CR	LATEX	25	D	2	CR	4	3.98	.
668	CORE	GFAA	4816-30	59	FIELD	2226	PL25L2CR	ENAMEL	25	L	2	CR	2	2.75	.
669	CORE	GFAA	4816-30	60	FIELD	2227	LF25L2CR	LATEX	25	L	2	CR	4	3.99	.
670	CORE	GFAA	4816-30	61	FIELD	2228	PL26D2CR	ENAMEL	26	D	2	CR	2	2.75	.
671	CORE	GFAA	4816-30	62	FIELD	2229	LF26D2CR	LATEX	26	D	2	CR	4	7.22	.
672	CORE	GFAA	4816-30	63	FIELD	2230	PL26L2CR	ENAMEL	26	L	2	CR	2	2.79	.
673	CORE	GFAA	4816-30	67	FIELD	2231	LF26L2CR	LATEX	26	L	2	CR	4	3.32	.
674	CORE	GFAA	4816-30	68	FIELD	2232	PL27D2CR	ENAMEL	27	D	2	CR	2	2.01	.
675	CORE	GFAA	4816-30	69	FIELD	2233	LF27D2CR	LATEX	27	D	2	CR	4	3.67	.
676	CORE	GFAA	4816-30	70	FIELD	2234	PL27L2CR	ENAMEL	27	L	2	CR	2	3.36	.
677	CORE	GFAA	4816-30	71	FIELD	2235	LF27L2CR	LATEX	27	L	2	CR	4	7.10	.
678	CORE	GFAA	4816-30	72	FIELD	2236	PL28D2CR	ENAMEL	28	D	2	CR	2	3.81	.
679	CORE	GFAA	4816-30	74	FIELD	2237	LF28D2CR	LATEX	28	D	2	CR	4	3.50	.
680	CORE	GFAA	4816-30	75	FIELD	2238	PL28L2CR	ENAMEL	28	L	2	CR	2	1.98	.
681	CORE	GFAA	4816-30	88	FIELD	2239	LF28L2CR	LATEX	28	L	2	CR	4	6.97	.
682	CORE	GFAA	4816-30	89	FIELD	2240	PL29D2CR	ENAMEL	29	D	2	CR	2	2.50	.
683	CORE	GFAA	4816-30	90	FIELD	2241	LF29D2CR	LATEX	29	D	2	CR	4	12.28	.
684	CORE	GFAA	4816-30	91	FIELD	2242	PL29L2CR	ENAMEL	29	L	2	CR	2	6.84	.
685	CORE	GFAA	4816-30	92	FIELD	2243	LF29L2CR	LATEX	29	L	2	CR	4	9.84	.
686	CORE	GFAA	4816-30	95	LCS	2397	LCS							72.25	72.25
687	CORE	GFAA	4816-30	96	MMB	2425	MMB							7.41	.
688	CORE	GFAA	4816-30	97	MB	2450	MB							1.65	.

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OBS	MATRIX	INSTRMNT	PREPBTCH	RUN_NO	QC_ID	LAB_ID	SAMPLEID	SUBSTRAT	CLMIX	SOILTYPE	SOILBTCH	SMPLTYPE	MIL	C	AMOUNT	SRMREC
689	CORE	GFAA	4816-30	12	FIELD	2244	PL30D2CR	ENAMEL	30	D	2	CR	2		3.430	.
690	CORE	GFAA	4816-30	13	FIELD	2245	LF30D2CR	LATEX	30	D	2	CR	4		4.960	.
691	CORE	GFAA	4816-30	14	FIELD	2246	PL30L2CR	ENAMEL	30	L	2	CR	2		2.990	.
692	CORE	GFAA	4816-30	15	FIELD	2247	LF30L2CR	LATEX	30	L	2	CR	4		3.760	.
693	CORE	GFAA	4816-30	16	FIELD	2248	PL31D2CR	ENAMEL	31	D	2	CR	2		3.560	.
694	CORE	GFAA	4816-30	17	FIELD	2249	LF31D2CR	LATEX	31	D	2	CR	4		5.040	.
695	CORE	GFAA	4816-30	21	FIELD	2250	PL31L2CR	ENAMEL	31	L	2	CR	2		2.200	.
696	CORE	GFAA	4816-30	22	FIELD	2251	LF31L2CR	LATEX	31	L	2	CR	4		6.900	.
697	CORE	GFAA	4816-30	23	FIELD	2252	PL32D2CR	ENAMEL	32	D	2	CR	2		3.660	.
698	CORE	GFAA	4816-30	24	FIELD	2253	LF32D2CR	LATEX	32	D	2	CR	4		4.620	.
699	CORE	GFAA	4816-30	25	FIELD	2254	PL32L2CR	ENAMEL	32	L	2	CR	2		5.330	.
700	CORE	GFAA	4816-30	26	FIELD	2255	LF32L2CR	LATEX	32	L	2	CR	4		3.940	.
701	CORE	GFAA	4816-30	30	FIELD	2256	PL32D0CR	ENAMEL	32	D	0	CR	2		5.150	.
702	CORE	GFAA	4816-30	31	FIELD	2257	LF32D0CR	LATEX	32	D	0	CR	4		2.720	.
703	CORE	GFAA	4816-30	32	FIELD	2258	PL32L0CR	ENAMEL	32	L	0	CR	2		3.930	.
704	CORE	GFAA	4816-30	33	FIELD	2259	LF32L0CR	LATEX	32	L	0	CR	4		2.870	.
705	CORE	GFAA	4816-30	34	FIELD	2332	PCPLL1CR	ENAMEL		L	1	CR	2		3.570	.
706	CORE	GFAA	4816-30	35	FIELD	2337	PCLFL1CR	LATEX		L	1	CR	4		5.760	.
707	CORE	GFAA	4816-30	39	FIELD	2342	PCLFD1CR	LATEX		D	1	CR	4		6.460	.
708	CORE	GFAA	4816-30	40	FIELD	2347	PCPLD1CR	ENAMEL		D	1	CR	2		4.160	.
709	CORE	GFAA	4816-30	41	LCS	2390	LCS								80.250	80.25
710	CORE	GFAA	4816-30	42	MMB	2423	MMB								4.440	.
711	CORE	GFAA	4816-30	43	MB	2451	MB								3.120	.
712	CORE	GFAA	4816-32	44	FIELD	2352	PCLFD2CR	LATEX		D	2	CR	4		4.940	.
713	CORE	GFAA	4816-32	48	FIELD	2357	PCPLD2CR	ENAMEL		D	2	CR	2		2.720	.
714	CORE	GFAA	4816-32	49	FIELD	2362	PCPLL2CR	ENAMEL		L	2	CR	2		3.390	.
715	CORE	GFAA	4816-32	50	FIELD	2367	PCLFL2CR	LATEX		L	2	CR	4		5.420	.
716	CORE	GFAA	4816-32	51	LCS	2377	LCS								77.500	77.50
717	CORE	GFAA	4816-32	52	MMB	2422	MMB								7.120	.
718	CORE	GFAA	4816-32	53	MB	2452	MB								1.990	.
719	CORE	GFAA	4816-37	55	FIELD	2329	PCPLL1RR	ENAMEL		L	1	RR	2		19.650	.
720	CORE	GFAA	4816-37	58	FIELD	2359	PCPLL2RR	ENAMEL		L	2	RR	2		19.025	.
721	CORE	GFAA	4816-37	59	LCS	2455	LCS								93.750	93.75
722	CORE	GFAA	4816-37	60	MMB	2456	MMB								0.880	.
723	CORE	GFAA	4816-37	61	MB	2457	MB								0.290	.

REPORT DOCUMENTATION PAGE

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13. ABSTRACT (Maximum 200 words)

The U.S. Environmental Protection Agency (EPA) has recommended using a general all-purpose cleaner or a cleaner made specifically for lead for weekly cleaning of residential surfaces. EPA also recommends the use of trisodium phosphate (TSP) detergent to clean lead-contaminated dust from surfaces after residential lead hazard control work to achieve post-abatement clearance standards. Because of negative effects of phosphate detergents on aquatic ecosystems, EPA conducted a laboratory study in 1996/97 to evaluate the cleaning efficacy of many commercial household cleaners that could be used to remove lead-contaminated dust from residential surfaces. The study results suggested that low surface tension cleaners remove marginally more lead dust than high surface tension cleaners.

The present study is a follow-up to the previous study. The effect of surface tension and phosphate content on cleaning efficacy was further investigated using a wider range of these parameters and a single household cleaner. Surfaces soiled with lead-containing soil were cleaned with a sponge, then half were wiped with a baby wipe. All cleaned surfaces were cored, and all sponges, wipes, and core samples were analyzed for lead.

This study showed that surface tension and phosphate content had no statistically significant effect on residual lead found on the test surfaces. The weak link found in the previous study between these parameters and cleaning efficacy could neither be refuted nor strengthened.

14. SUBJECT TERMS
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